PLASTICS TECHNOLOGY

THE MAGAZINE OF APPLIED ENGINEERING

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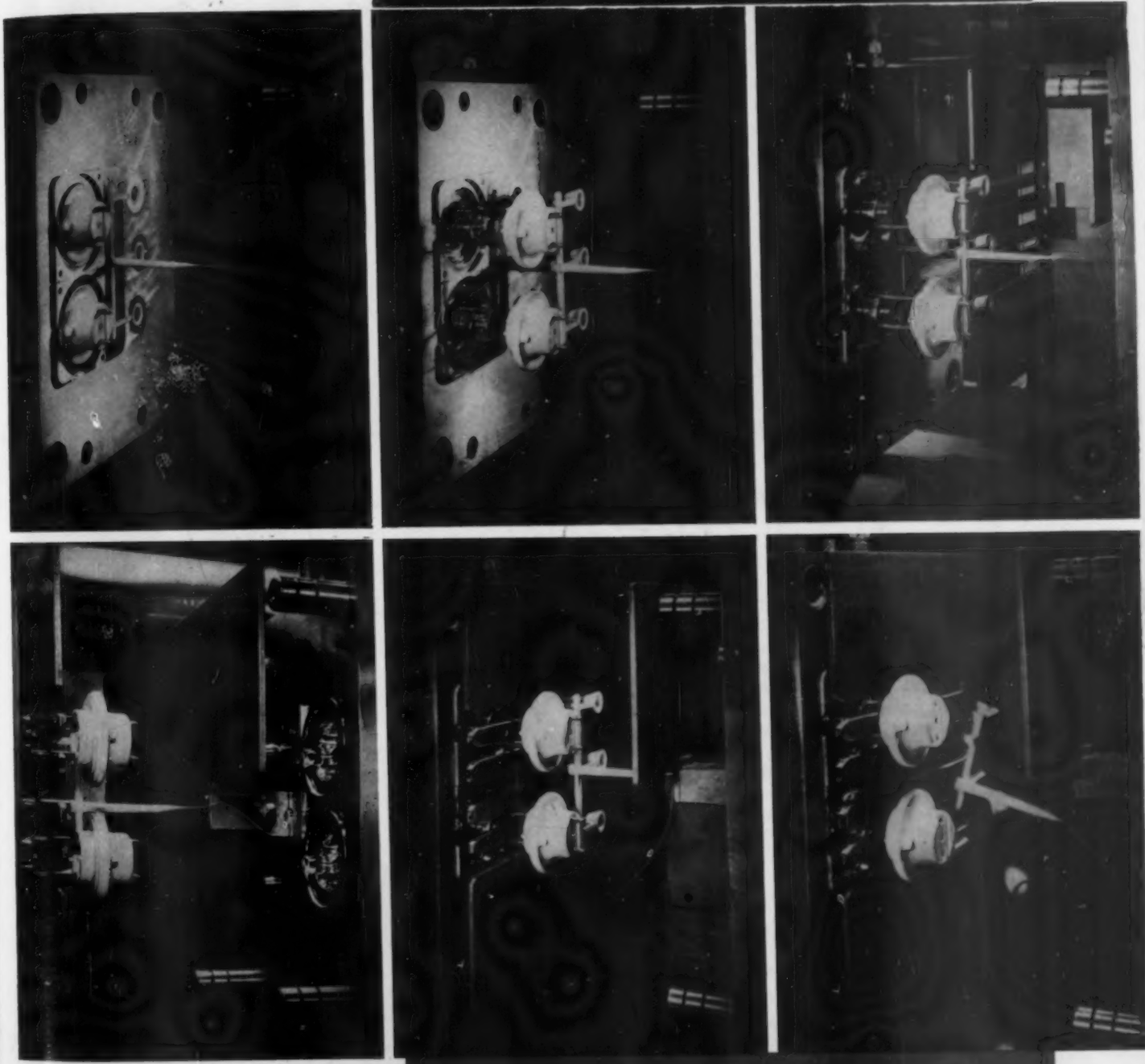
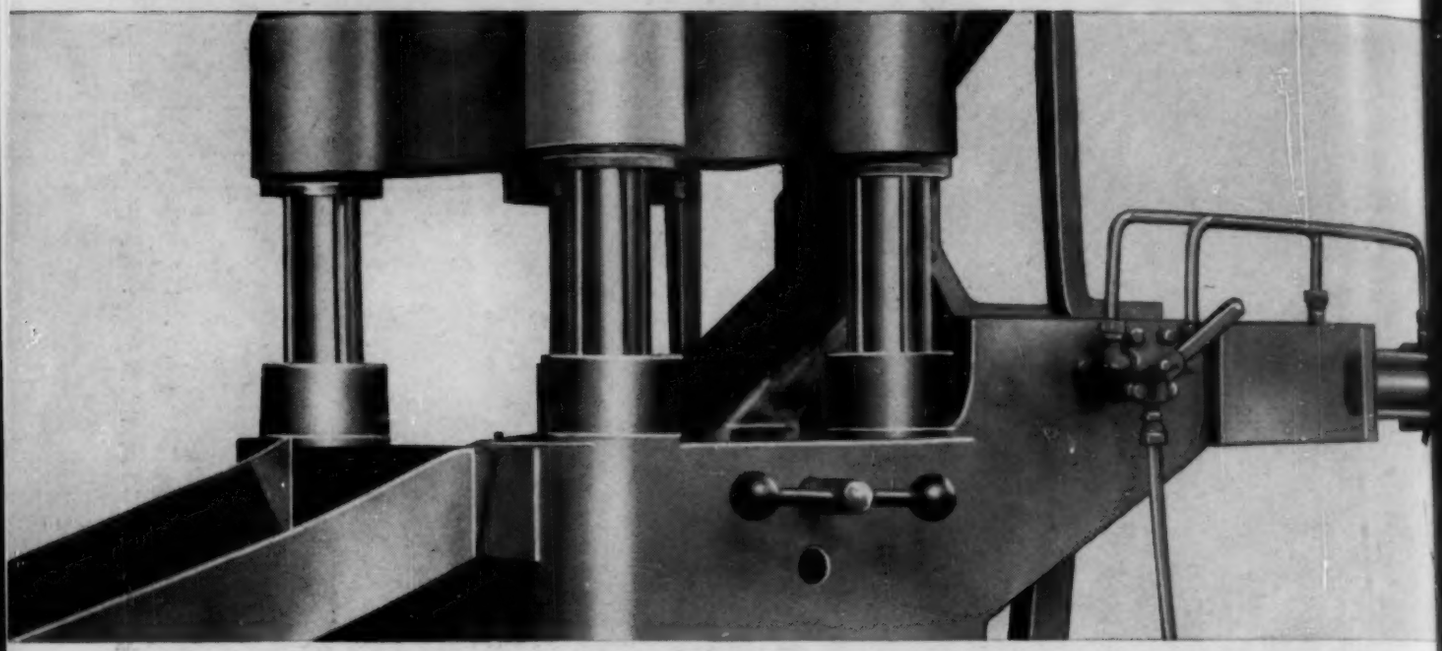


SEQUENCE SHOWING EJECTION OF MOLDED PARTS FROM A STOKES AUTOMATIC INJECTION MACHINE

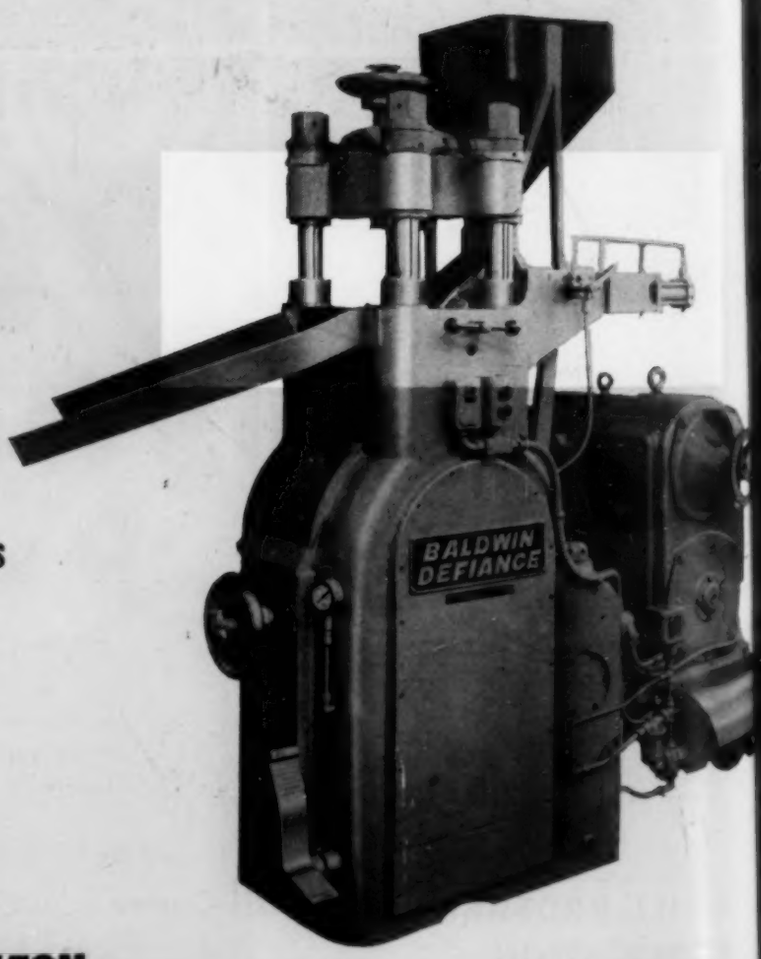
an article by O. M. White (page 54)

A BILL BROTHERS PUBLICATION

How precision alignment increases die set life in Baldwin preform presses



Typical of the many outstanding features of Baldwin compacting presses is Baldwin's use of four rigidly guided tie rods to provide precise die alignment. Two connecting rods transmit balanced pressure from the crankshaft to each tie rod. The resulting uniform force, together with rigid guiding, maintains true parallel motion of the upper platen. This increases the life of the machine and of the die sets used. Precision alignment is just one of many practical benefits you will get from the careful design and engineering that goes into the Baldwin Models 20 and 45. These many advantages are proved through years of rugged service in the field . . . added proof that Baldwin plastics molding and preforming presses are the finest in the industry. Why not send today for Bulletin #3103 containing complete details? Address Dept. 4863, Baldwin-Lima-Hamilton Corporation, Philadelphia 42, Pa.



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- **Cleanline design prevents contamination, speeds cleaning.**

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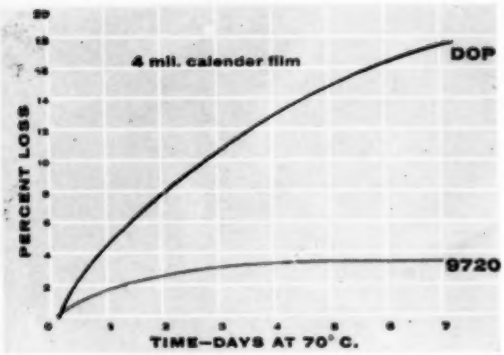

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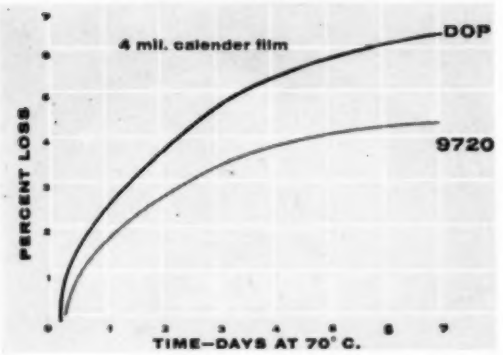

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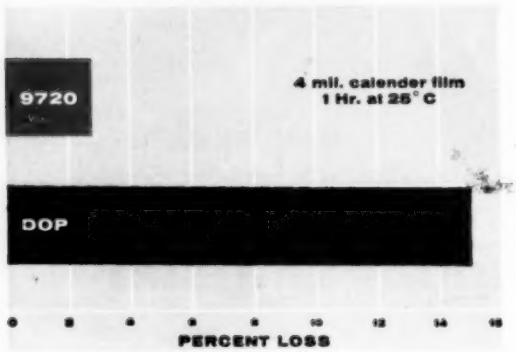

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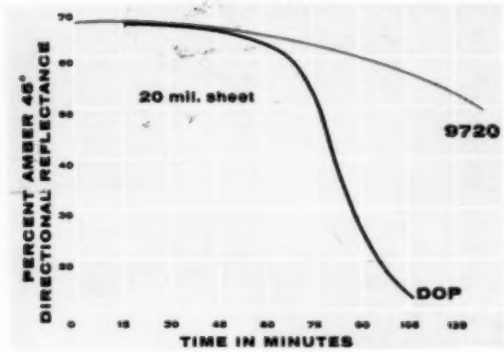

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Letters to the Editor

Dear Sir:

We find your new publication an extremely interesting and illuminating magazine. We would like to compliment you on your choice of articles which appeared to be of unusual interest and timing. I would like to extend to you our best wishes for success in your new venture.

R. J. Carey
Compo Chemical Company, Inc.
Boston, Mass.

• • •

Dear Sir:

We are desirous of obtaining names and addresses of jobbers or distributors calling upon or supplying the reinforced plastics industry. Any information you can give us on such companies would be appreciated.

Robert Steinman
Ram Chemicals, Gardena, Calif.

(Our lists essentially are of manufacturers and suppliers, rather than of jobbers or distributors. Unfortunately, therefore, the list requested cannot be supplied. As always, we are willing to answer specific inquiries wherever possible.—Editor).

• • •

Dear Sir:

On page 400 of your August issue, we note an inquiry from an unidentified company concerning additives which might be introduced into commercial polystyrene with certain specific ends in mind.

We are custom compounders with considerable experience along these lines, and request that you suggest to this company that they contact us so that we might explore the possibilities of this suggestion with them in detail.

R. W. Spake, Technical Sales
L. A. Dreyfus Co.
South Plainfield, N. J.

(This reply has been forwarded to the original inquirer.—Editor)

• • •

Dear Sir:

Can you inform us who manufactures a polyethylene plastic under the trade name, Durcon. It is made conductive by loading with carbon. We are very anxious to purchase this material for use in our medical enuresis alarm.

Signal Trainer Co.
San Francisco, Calif.

(We have been unable to identify Durcon polyethylene plastic. Can our readers tell us who makes this plastic? —Editor)

• • •

Dear Sir:

The guest editorial by D. Lorin Schoene (entitled "The Need for Engineering Data") in the July issue is very commendable.

The writer has frequently questioned the delay in using reinforced or laminated plastics for such items as residential doors and frames, building coping, elevator cabs, gasoline pump housing, ornamental rails and grillwork, window sash, fan blades, filing fixtures, swimming pools, guard rails, and probably 101 other potential applications.

Mr. Schoene's advice will undoubtedly prevent premature applications where the tail would wag the dog.

Joseph G. Conrath
Conrath & Powell, Consulting Engineers, New York, N. Y.

• • •

Dear Sir:

Recently, we introduced to the plastics industry a new mold releasing agent, Mold-Wiz. Your magazine, as well as other trade publications, ran a story on it (July issue, page 314).

A careful record was kept of the inquiries from manufacturers requesting literature, additional information, and samples of Mold-Wiz. Particular attention was given to the inquiry source; date of inquiry and when sample was mailed; date and quantity of first pur-

chase of the product by the inquirer; and reorders from the inquirer.

In compiling this information, we discovered that PLASTICS TECHNOLOGY far exceeded all other publications in obtaining for us bona-fide orders for our product, although your publication drew the least number of inquiries from your readers. This clearly indicated to us the truth of the old adage that it is not the quantity but the quality that counts.

The quality of your magazine is surpassed only by the quality of its readers.

Hunter W. Smith, Sales Director
Axel Plastics Research Laboratories, New York, N. Y.

• • •

Dear Sir:

In your August issue, there appeared an article entitled, "Plastics as Capacitor Dielectrics—5. Teflon."

As manufacturers and distributors of plastic materials including electrical insulation, we would like to receive reprints of the five articles in the series on plastic capacitor dielectrics, especially the fifth paper dealing with Teflon.

Our parent company, The Polymer Corp., retains your magazine in a library, but there are various points in the articles that are of interest to our technical staff, so individual reprints are required.

If you can send us four reprints of the article we will appreciate it very much.

Paul B. Hendel, Jr.
Polypenco, Inc.
Reading, Pa.

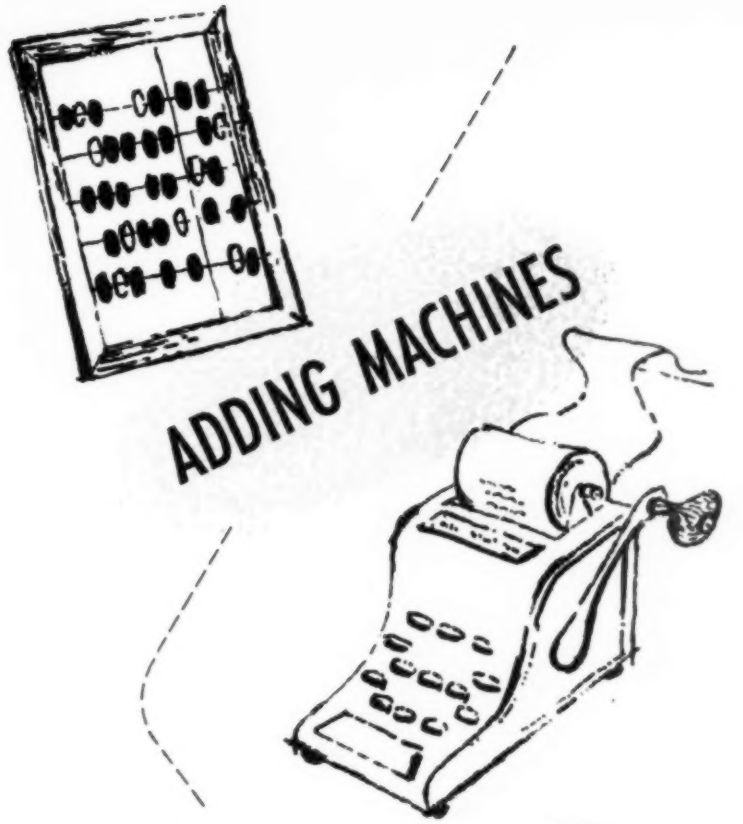
(The requested reprints were sent. This letter is being printed to inform our readers that a limited number of tearsheet copies of all published articles can be furnished them upon request as long as stocks permit. —Editor).

• • •

We invite letters from our readers for publication in these columns. Such letters may be of comment or criticism, requests for information, or of general interest. The only requirement is that all letters must be fully identified as to name of sender, company affiliation, and address.

Letters requesting information on technical or engineering problems will be printed to elicit replies by the readers, either directly or through these columns. Upon request the identities of such "problem" letters will not be divulged.

—The Editor



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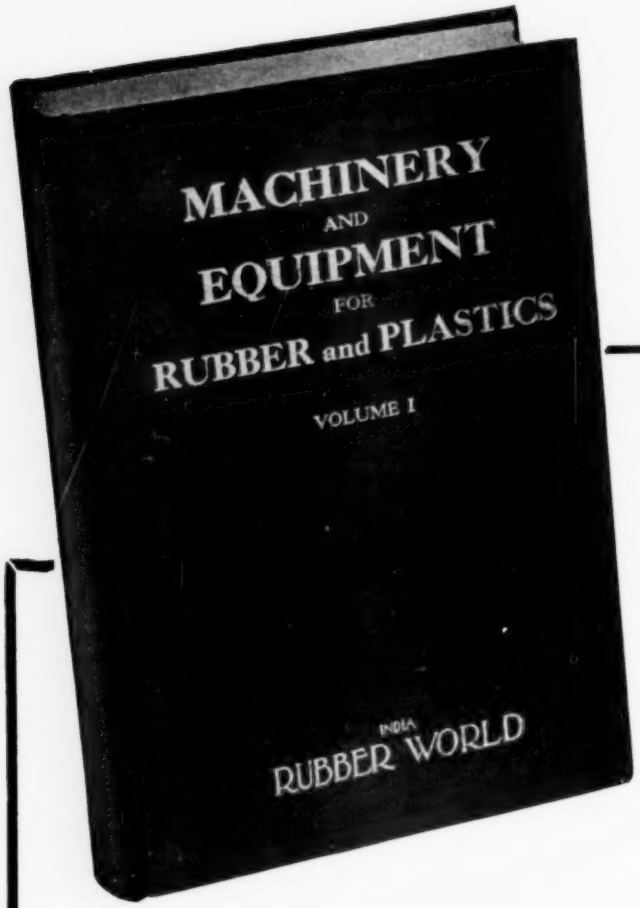

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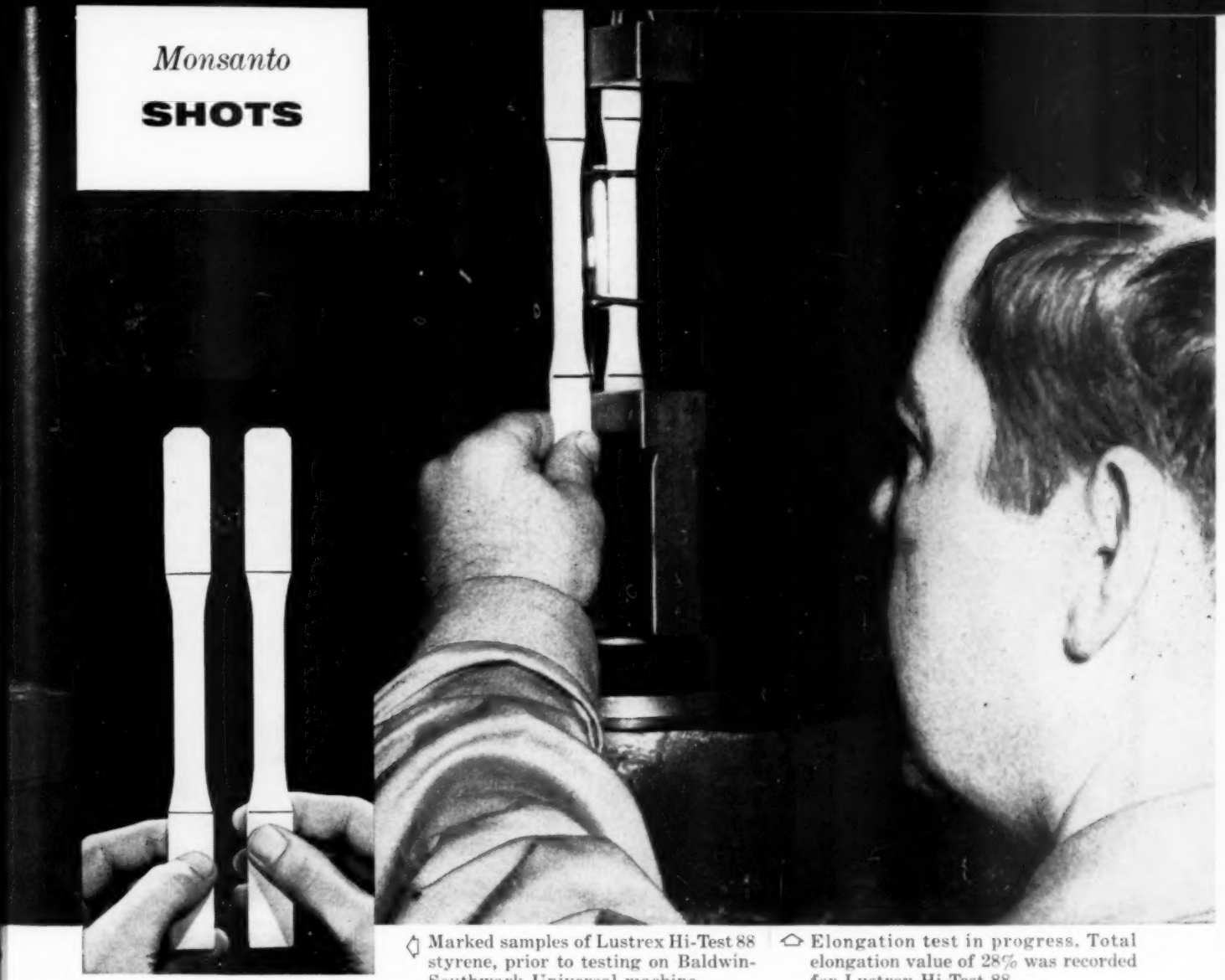

◇ Marked samples of Lustrex Hi-Test 88 styrene, prior to testing on Baldwin-Southwark Universal machine.

◇ Elongation test in progress. Total elongation value of 28% was recorded for Lustrex Hi-Test 88.

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CABFLEX®DI-OZ (di-iso-octyl azelate)
CABFLEX DI-BA®(di-iso-butyl adipate)
CABFLEX®TCP (tricresyl phosphate)
CABOL 100 (hydrocarbon oil plasticizer)

NEWS in BRIEF

Polyurethane foam market should rise shortly to over 100-million pounds annually, predicts Nopco Chemical's president Wechsler. Nopco's expansion into cellular plastics has its plastics division opening two new plants this year and another in 1956.

One plastics misapplication can blacken the reputation of all plastics and bring a decline in their high level of acceptance, says S. S. Zimmerman, general manager of Vacuum Forming Corp. (see guest editorial, page 551). The plastics industry has a stake in vacuum forming because each advance by one of its parts can be converted into progress for the industry as a whole.

Epoxy tooling cuts costs for the Air Force's new turbo-jet fighter, the F101A Voodoo. The epoxy parts, developed by Ren Plastics, save 40% in tool costs, 40% in make-up time, and about 75% in weight as compared with metal tooling.

Torrent of company expansions in plastics continues. New administration building being erected by Alsynite in San Diego, Calif. Carbide & Carbon Chemicals is building new facilities at Texas City to more than double its vinyl acetate output. Dow is erecting new Styrofoam facilities at Torrance, Calif. A Marlex polyethylene plant, annual capacity 110-million pounds, is being built by Phillips Chemical in Texas. Pittsburgh Coke & Chemical will erect a new phthalic anhydride plant. An expansion of its Oaks, Pa., plant is under way by Synthane. Synthetic Products has expanded its Cleveland, O., stabilizers plant. Plant expansion at Westchester Plastics will increase its production and storage facilities.

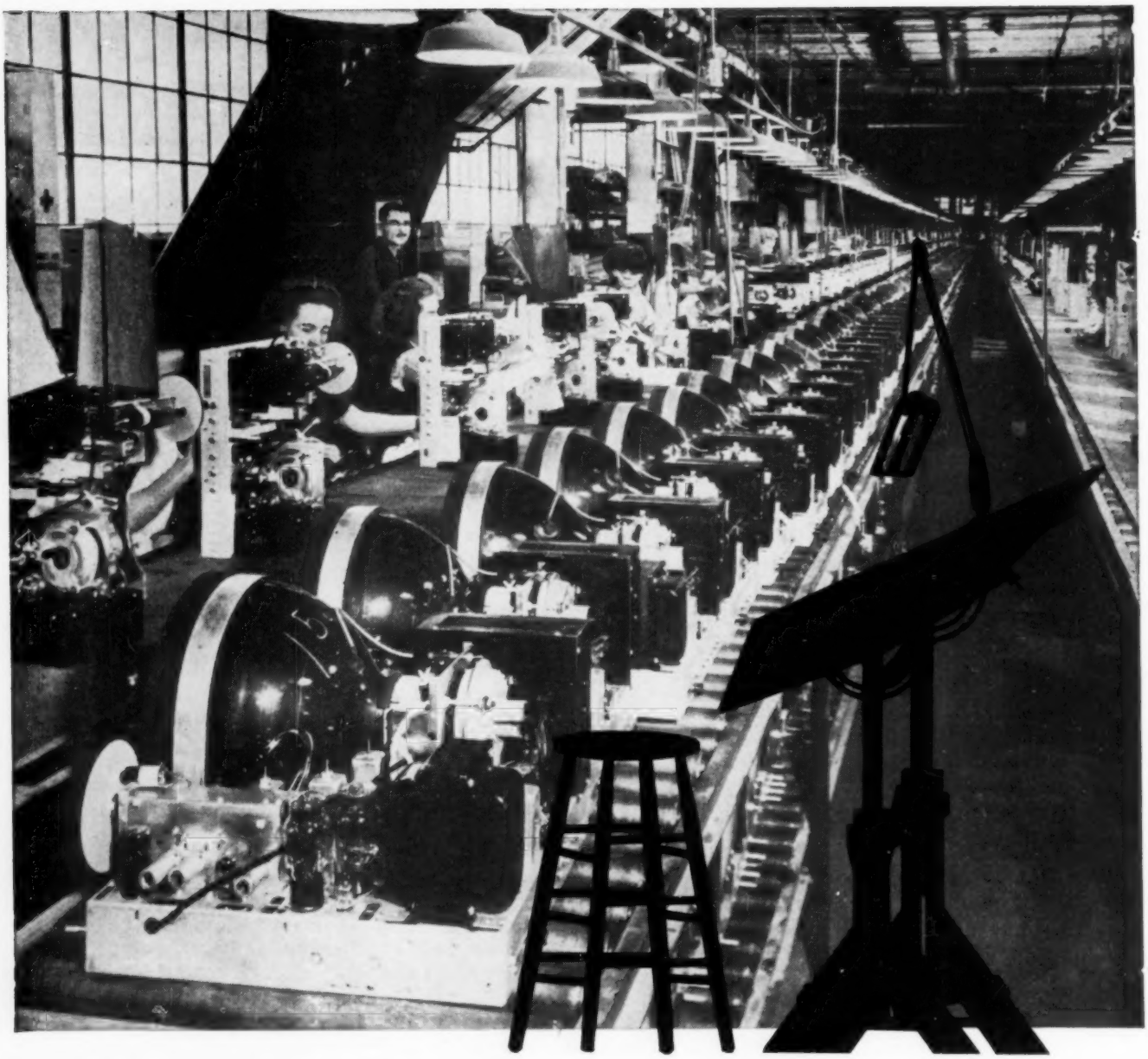
Plant openings announced last month: Commercial Solvents' new nitroparaffins plant at Sterlington, La., now in full operation; and Durez Plastics' new $5-million plant at Kenton, O., for long production runs of its highest-volume compounds. Monsanto opened a new lab at Springfield, Mass., doubling its research facilities.

Company changes in the plastics industry included the establishment of a new firm, Amco Plastic Materials, to buy, sell, and process all types of thermoplastics. Hull-Standard bought the molding press business of Standard Machinery, which now will specialize in extruding and wire coating units. Monmouth Craftsmen established to develop plastic products for end-users. Industrial, refrigerator, and molded plastic sales by Panelyte were merged into one sales group. U. S. Rubber transferred its plastics molding equipment from Chicago Die Mold to its Fort Wayne, Ind., plant.

New Materials to be noted (see page 572): four silicone molding compounds; non-woven fibrous mat reinforcements; heat resistant styrene compound; isocyanate resin with catalyst for foaming applications; high-styrene calendering compound; and two phthalate ester type plasticizers.

New Equipment of interest (see page 574): heavy-duty drum tumblers; automatic forming-printing-sealing packager; tool air hose valve couplings; automatic press-loading table; satin finisher for laminate surfaces; and automatic compression press.

New Products to be mentioned (see page 576): nylon-phenolic padding; vinyl liquid-measuring dispenser; polyethylene caps for grease fittings; styrene furniture drawer liners; all-butyrate sun glasses; expanded styrene ice bucket; Dynel-vinyl blanket; nylon-base tinless solder; glass mat-supported polyester adhesive; and reinforced plastic bars, boat, silo caps, and nylon-vinyl plastic covering.



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PLASTICS TECHNOLOGY

OCTOBER, 1955

EDITORIAL: The National Plastics Institute Proposal

In our August editorial, we proposed the establishment of a National Plastics Institute supported by all branches of the domestic plastics industry This Institute would aim primarily at gathering the engineering data upon which to base the industry's growth.

Following in this vein, our September editorial gave suggestions on the organization, financial support structure, and physical location of the proposed Institute.

To round out this series of editorials, we wish to reiterate and enlarge on the suggested objectives for the Institute's program.

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The primary objective, as previously stated, would be the accumulation of engineering data on all plastic materials. Plastics are greatly handicapped by lack of this data which prevents their full expansion into non-glamorous, non-novelty fields of application that are the true potentials for future industry growth. Since these applications include building, vehicular, and marine structures, industrial and agricultural uses, and electronic components, to name only a few, the availability of such engineering data will bring almost unimaginable future growth of the plastics industry.

Another objective could be application-type studies of specific plastic problems, such as plastics toxicology, low-temperature behavior of plastics, and others. Some cooperative, industry-sponsored studies of this type, such as the work on plastic pipe, already are in progress, but all future work could be systematized and combined at the Institute.

A third objective could be the conducting of basic or fundamental work on plastics, such as studies of the polymerization reaction, and mechanisms of plasticization and stabilization.

Other objectives for the proposed Institute spring to mind, and the subject is worthy of serious consideration by the industry. For example, the Institute could well have an extension program aimed at the professional and practical education and training of plastics technologists.

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The proposal that the industry consider the establishment of a National Plastics Institute invokes many avenues of thoughts. It is a subject brought up repeatedly by plastics technologists who point to successful institutes in foreign countries, and decry the lack of an American facsimile.

We invite comments from all members of the plastics industry on the subject of the proposed Institute, and will act as a sounding board for the dissemination and discussion of these opinions. As soon as a coherent, practicable plan emerges from such discussion, we will be ready to serve in any duly-designated, impartial body to implement and carry out the wishes of the plastics industry.

Arthur M. Merrill

Editor

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A native of North Carolina, Dr. Parks holds degrees in chemistry from the University of North Carolina (B.S., 1938), Georgia Tech. (M.S., 1940), and the University of Maryland (Ph.D. 1943). He joined Sharples Chemicals, Inc., in 1942 as a chemist, and worked his way up to products manager in 1950-1951. Dr. Parks became associated with Bee Chemical Co. in 1951 as director of research and development, and became vice president in 1952. He assumed his present position with Logo in 1952.

In his work at Logo, Dr. Parks is especially active in new product research and development, and has authored several papers on the subject of decorating plastics. He is a member of SPE, ACS, Alpha Chi Sigma, and the Paint, Varnish & Lacquer Association.

Decorating Molded Plastics—Part I

The beginning of a detailed two-part survey of decorating paints, methods, and equipment, emphasizing the effects of plastic part design and molding.

LLOYD E. PARKS, *Vice President & General Manager*
Logo, Inc., Chicago, Ill.

Painting is the last in the long series of steps required in producing decorated plastic parts, but the quality of decoration and the ease of application are quite dependent on all previous operations. Agreement through compromise must be reached between the artist and the engineer retaining as completely as possible the individuality and beauty of original design, but making such changes as are necessary to produce quality parts practically and economically.

Decorating technology must be understood, and decorating should be considered from the earliest stages of design. Thus, it will be helpful to look closely at the part itself and study the effects of design, molding, and surface preparation on decorating with paint and by roll-leaf hot stamping.

The Plastic Part

Design and Molding

Plastic parts must be molded relatively free of stresses in order to avoid unnecessary crazing or cracking in use. Stresses may be introduced when parts are machined, flexed, shocked by impact, subjected to abrupt and uneven changes in temperature, or subjected to the action of certain solvents. Crazing occurs in the form of distinct surface cracks or minute frost-like internal cracks when these stresses exceed the tensile strength of the plastic.

When local stresses are present but are less than the tensile strength of the plastic, the area is under strain. Such strained parts may appear perfectly sound, but may crack or craze at a later time if additional stresses sufficient to exceed the tensile strength are introduced. Quality parts must be relatively strain-free, particularly if they are to be decorated by painting (1).*

Organic solvents required in the formulation of paints may be sufficiently active toward certain plastics to cause swelling of the surface, thus introducing stresses which may craze strained parts. Within limits, such crazing can be controlled by paint solvent adjustment. However, the best and safest way to avoid rejects by crazing is to decorate well molded, strain-free parts.

Usually, strained thermoplastic parts are the result of improper press cycles and temperatures which allow the plastic to cool too rapidly in the mold. Mold design, however, may also affect strain in molded parts. The mold should be designed to allow removal of the part with a minimum of flexing. Proper tapers should be used, particularly in the case of deep draws. Abrupt

* Numbers in parentheses refer to bibliography at end of article.

changes in plastic thickness may set up stresses as the result of uneven cooling. Accordingly, any designs, lettering, assembly lugs, reinforcing ribs, and inserts which commonly require variations in plastic part thickness should be engineered for a minimum of strain in the molded part.

If parts are to be decorated on the second (or back) surface, assembly lugs, reinforcing ribs, metal inserts, knock-out pins, and sprues must be located with care, since they may show through the clear plastic and spoil the effect of decorated areas. If parts are to be spray painted in more than one color, edges and corners must be sufficiently sharp so as to insure a close fitting of spray masks. Narrow, deep grooves and small holes must be sprayed at a very small angle which tends to fill the bottom of the groove or hole without coating the sides. Paint tends to pull away from small raised angles, making them more difficult to spray than large angles or rounded areas.

If a part is to be silk screened, the area must be flat or, at most, smoothly curved. If letters are to be filled by the spray and wipe method, they must be deep enough to avoid wiping the wet paint from the indentation.

If parts are to be decorated completely or in part by hot stamping, the method of hot stamping should be determined in advance and the part designed for the operation.

Annealing

With the best of design and molding technique, it is difficult to produce parts sufficiently free from strain to be decorated without crazing. Accordingly, many parts must be annealed to avoid losses in the form of rejects on the paint line. Some molders anneal all plastic parts, while others anneal only those parts that cannot be molded sufficiently strain-free for decorating. In the latter case, which represents most molders, the decision to anneal comes after all attempts to adjust paint solvents and molding cycles fail to produce parts satisfactory for decorating.

Since it is important that thermoplastic parts be relatively free from strain regardless of the effect of paint solvents, some companies specify that all plastic parts be spot-checked for strain by the use of designated solvents. Polystyrene may be checked by dipping in n-heptane for about one minute. If the part is strained enough to craze in this test, it is considered unsatisfactory for the application; if it does not craze, it is relatively free from strain and satisfactory. Such strain-free parts may be painted without fear of crazing. In like manner, ethyl alcohol or ethyl acetate may be used to determine the amount of stress in acrylic parts. The time required for crazing to show after immersion may vary from 30 seconds to two minutes, depending on the type and flow of the acrylic. Tests of this nature must be adjusted to suit the requirements. From the standpoint of decoration, it is necessary only to determine in advance whether a part is likely to be crazed by the application of paint.

The most satisfactory method of annealing is to apply heat at a relatively low temperature for a long period of time. Polystyrene is commonly annealed at approximately 140° F. for 4-8 hours, depending on the type and size of the part and whether the parts are being annealed in the package or subjected directly to the heat. Acrylic parts may be annealed at 135-160° F. for varying lengths of time, depending on the type of part, the grade of acrylic plastic, and the package. Acrylic or polystyrene parts may be taken directly from the press and dipped into hot water for annealing, and 7-10 minutes at 140-180° F. should be sufficient for most parts. However, the temperature and time cycle must be worked out for each part and, here again, from the standpoint of painting it is necessary only to anneal sufficiently for painting without crazing.

Fig. 1. Suction feed paint spray gun and cup

There is a chance of warping the parts in the annealing operation and, in some cases, it is necessary to clamp them in a jig arrangement to maintain shape.

When annealing in a water bath, it is common practice to use a small amount of detergent to promote wetting of the part, and rapid draining upon removal of the part from the bath. The wetting agent also may serve to reduce static electricity on the part, thus lowering the amount of dust collected between annealing and decorating. Such wetting agents should be selected with extreme care, since they remain on the part and may adversely affect paint adhesion.

Cleaning the Part

It is desirable that plastic parts be designed so that they can be molded relatively strain-free without the use of mold lubricant. Excessive amounts of mold-release lubricants must be removed because they interfere with paint adhesion. Moderate amounts of stearate lubricant may be removed with solvents which do not attack the plastic surface. Silicones are more difficult to remove with solvents, and Dow Chemical recommends a solution of four ounces of Oakite No. 24 in one gallon of water for removing silicone lubricant (2). Dow suggest a 20-minute immersion of the molded part in the solution at 145° F., followed by a water rinse. This solution also will remove stearates and other contaminates.

Parts should be dust-free for decorating. Accordingly, it is helpful to dip the plastic parts in an antistatic solution immediately after molding in order to reduce the amount of dust contamination during the

time interval between molding and painting. Anti-static agents must be selected which do not adversely affect the paint adhesion. Some parts are wiped just before painting to remove dust, lubricant, and other forms of contamination.

The Paint

Types of Paint

Plastics differ in physical and chemical properties, and these differences will affect the type of paint required for the plastic. It is important, therefore, to select a paint specifically recommended for the type of plastic to be decorated.

In the plastics industry, we use the term "paint" in a broad sense to cover both lacquers and enamels (3). Lacquers are particularly desirable for use on thermoplastic surfaces because their films harden without baking. This eliminates the possibility of heat shrinkage and warpage of expensive molded parts. In addition, parts rejected because of blotches or errors in painting usually can be reclaimed quite easily by removing the paint with a combination of paint solvents inactive toward the plastics.

Enamels harden by solvent evaporation and subsequent oxidation and/or polymerization. Enamels may be considered as thermosetting, and particularly useful for thermosetting plastics such as phenolics, polyesters, ureas, and melamines where reasonably high baking temperatures can be tolerated without damage to the plastic part.

Paints vary considerably in quality, and should be selected to meet the requirements of the application. Decorated parts used in refrigerators must have excellent grease and humidity resistance. Automotive parts, exterior signs, and all other plastic parts designed for outdoor use must be decorated with paints composed of resins and pigments having good light resistance, moisture resistance, and all-around exterior durability. The toy industry often considers adhesion, gloss, and ease of handling in application more important than superior film qualities.

Plastic parts are decorated to make them look better and, in most cases, the paint serves no other purpose. Accordingly, color is most important. To facilitate production color matching and color control, it is recommended that designers use a reasonable number of pigments, no more than three or four at the most, in arriving at colors. It is most important to work with single-pigment colors in blending at the design stage. It is a mistake to blend three or four matched colors, each of which may contain three or four pigments, and expect an exact or even an approximate match in production.

Paints are mixtures, and the pigments settle up on standing. Some settle rapidly and others only slightly, but it is always necessary to stir well before using to assure uniformity. Unless careful study is given to selecting an alternate, the recommended thinner should always be used. Adhesion, gloss, humidity blush resistance, cratering, orange peel, etching of the plastic, crazing of the part, drying time, and stability of the paint system may depend on the thinner.

Photo by Conforming Matrix Corp.

Fig. 2. Plug mask equipped with pneumatic clamping fixture. Below (left to right) are underside of plug mask; decorated plastic part; and foot pedal and air line for clamp

Paint Control

In setting up a decorating job, it is important that the paints be evaluated thoroughly and specified to meet the requirements of the application. For purposes of the specification, such points as grease resistance, humidity resistance, stain resistance, light resistance, heat resistance, abrasion resistance, gloss, adhesion, viscosity, and percent solids may be checked. Once the decorating job is under way, it is impossible

Photo by Finish Engineering Co.

Fig. 3. Automatic mask washing machine is pneumatically operated

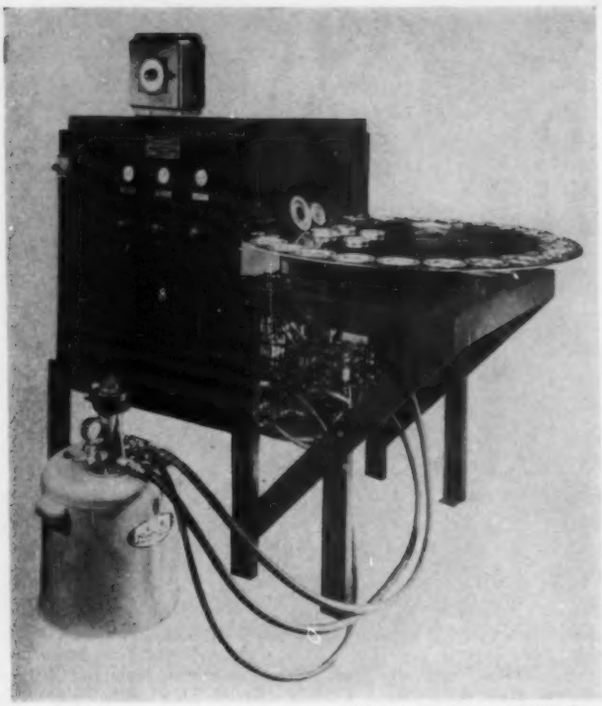

Photo by Conforming Matrix Corp.

Fig. 4. Automatic spray unit applies one color with simple mask

to check all these points on each incoming batch of paint. Such control is unnecessary since it is improbable that basic errors in formulation will occur that cannot be detected by less extensive routine control.

However, each batch should be mixed thoroughly and checked for color. If special thinners or retarders are used to correct problems in production, the color should be watched to catch any irregularities that might arise from improper compounding.

Production parts should be checked by visual inspection, and a spot check should be made for adhesion. Many companies have accepted transparent Scotch tape #600 and masking tape #202 as the standard materials for the adhesion test.

Decorating Methods and Equipment

In decorating molded plastic parts, color is applied by many methods including spraying, silk screening, dipping, rolling, and hot stamping. Basically, these are the same methods used for years in decorating other surfaces (4, 5).

Spray Coating

Spray coating is widely used for decorating all types and sizes of plastic parts. The method is particularly adaptable for painting large areas and uneven surfaces, and for the application of multiple colors by the use of spray masks. Spray coating is quite economical, and productivity is high in well-equipped paint shops. Spray guns, feed tanks, spray masks, and other equipment must be selected to do the job most efficiently.

Suction feed guns and reasonably small suction cups are commonly used in spraying small areas and short runs (see Figure 1). In this equipment, a stream of air passing the nozzle of the spray gun creates a vacuum which pulls the paint up through the tube from the attached cup. When the paint contacts a stream of air, it is atomized and blown forward. Upon meeting the air coming from the two or more holes on the outside of the air cap, the paint is flattened and spread with further atomization to form the conventional spray fan. Uniformity of the paint film depends on careful adjustment of paint viscosity, air pressure, and gun opening.

Pressure feed tanks, such as that used with the semi-automatic spray machine shown in Figure 4, are used almost exclusively for spraying large areas or long runs requiring a large volume of paint. The tank is connected directly to a conventional hand or automatic spray gun by a fluid hose, and the paint is forced from the tank to the gun by air pressure. Since pressure feed tanks are stationary in operation, they should be equipped with air agitators to keep the paint well mixed. This is particularly important in spraying paints which have suspended particles, such as pearl essence and metallic powders.

Uniformity of spray application is particularly important in spraying metallic and pigmented metallic finishes. If one panel is sprayed extremely dry and another extremely wet, the colors may differ appreciably due to a difference in the degree of flooding of the powder. If sprayed dry, the film may be almost immobile when it hits the plastic, thus allowing very little flooding or orienting of the powder. If the film is extremely wet, the powder may flood excessively and give a quite different color.

For spray application, paints are usually thinned to a standard viscosity suitable for the particular job. Usually, this viscosity ranges downwards from a maximum of about 25 seconds at 20° C. in a No. 4 Ford

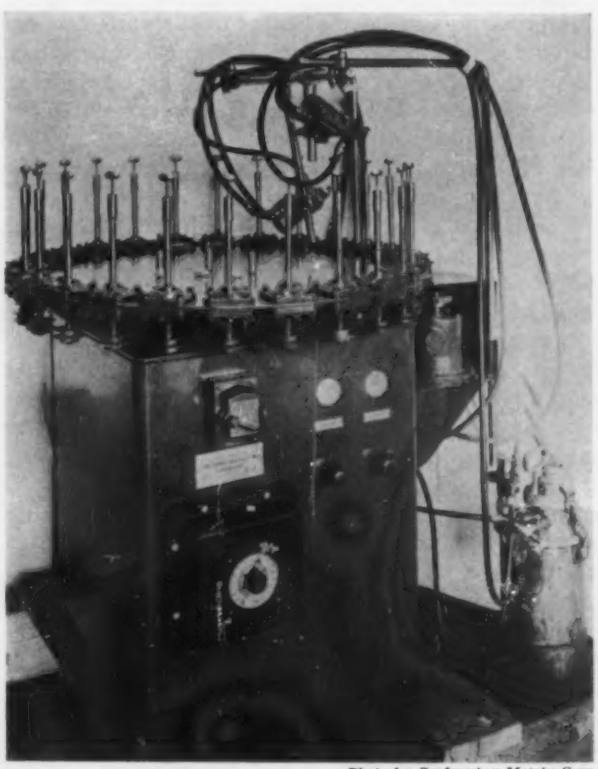

Photo by Conforming Matrix Corp.

Fig. 5. Automatic spray unit applies one color without mask

Table 1. Classification of Paint Solvents by Boiling Point

Low Boiling	Intermediate Boiling	High Boiling	Extra High Boiling
Methanol	Isopropyl alcohol	Amyl acetate	Cellosolve acetate
Ethyl acetate	Sec-butyl acetate	Butyl acetate	Butyl Cellosolve
Isopropyl acetate	Methyl Cellosolve	Butanol	Butyl lactate
Acetone	Methyl isobutyl ketone	Diisobutyl-ketone	Methyl Carbitol
Methyl-ethyl ketone	Toluene	Xylene	SC-150
Hexane	VM & P naptha	SC-100	
Heptane		Methyl Cellosolve acetate	

cup. If the viscosity is too high, serious difficulties are encountered in spraying. On the other hand, material can be sprayed at extremely low viscosity if the solvent system is well formulated, and if the pressure and the gun settings are adjusted properly.

The paint must be thinned sufficiently to spray, yet the film must be viscous enough to hang on corners and edges when the paint hits the part. This is accomplished by the using of a low-boiling solvent which evaporates between the spray nozzle and the plastic surface, allowing for an increase in viscosity in the paint before it hits the surface. Extra-high boiling, high boiling, and most of the intermediate-boiling solvents strike the plastic part with the paint as it is sprayed, and control the properties of the wet paint film. A group of solvents may be classified as shown in Table 1.

Solvent adjustments in spray paint vehicles and thinners are important in controlling etch and craze of the plastic, humidity blush, orange peel, cratering, adhesion, and, even color in extreme cases.

Parts may be decorated with more than one color by successive spray operations using a series of electro-formed metal masks that shield certain areas while other areas are painted. Basically, there are three types of masks; lip, plug, and block. The lip mask may be used for spraying depressed designs, in which case it is form-fitted to the area around the depression and has lips extending down the sidewalls of the depression. Another variation of the lip mask is used for shielding raised or embossed designs while the surrounding area is painted. Here again a lip extends down the sidewalls. It is usually desirable to have two colors meet on these vertical walls rather than at the surface edge of the area being masked.

The plug mask fits snugly in a depressed area to protect it while the surrounding area is being sprayed, and does not have a lip. The block mask confines paint to the general area of a small design or group of designs, and commonly is used in filling operations where excess paint must be removed by wiping. This mask simply reduces the area that must be wiped, thus lowering the cost of filling.

Electro-formed lip and plug masks must fit accurately for good work, and a different set of masks is usually needed for each mold cavity. Accordingly, it is highly desirable to have masks fitted to good production parts. Masks should be handled with reasonable care, and held snugly to the parts while the paint is being applied. A poor fit will allow paint to blow-by, with resultant clean-up cost or a poorly decorated part.

Precision masks may be held in place by either hand or gravity. However, there are many air clamping devices available for holding the masks in contact with the plastic parts being decorated. As shown in Figure 2, a clean plug mask is slipped into the grooves at the top of the fixture, and a clear plastic part placed on the jig attached to the air cylinder. In operation, the jig is actuated by the foot pedal, causing the shaft to rise vertically and bring the plastic part into register and into firm contact with the plug mask. The part is decorated on the second surface by plug-masking the white area to keep it clear of paint while the surrounding area is sprayed red. The entire back surface of the part is then sprayed white without masking.

Masks of several different types may be required to decorate one part. Conveyors may be used to move parts from one spray booth to another, and on to cleaning, inspection, and packaging stations.

Paint accumulates on masks as successive parts are sprayed, and must be removed at regular intervals for good production. The number of parts that can be sprayed before the mask is washed will depend on the job and, to a certain extent, on the paint formulation. Even under the best conditions, however, masks must be cleaned quite often. This may be done by hand brushing with solvent such as acetone, or by one of the many automatic mask washers on the market.

The washer shown in Figure 3 is simple in design and use. The mask is hung on the two pins, as shown in the photograph, except that the painted side should be turned toward the baffle at the back of the washer. By pulling the small lever on the left side of the unit, the slide door is closed and the mask lowered into the barrel of solvent, commonly acetone. The barrel is rotated and the solvent agitated by the baffle, thus causing the mask to be washed. This washer is completely air operated.

Good automatic spray equipment is available, and is widely used for long production runs. This machinery is quite versatile and, with minor changes, can be adapted for a variety of successive decorating jobs.

The machine shown in Figure 4 will spray up to 1,200 toy automobile wheels per hour. Of the two items leaning against the housing at the back of the turntable, the one at the left is a simple metal mask used to paint

(Continued on page 558)

Mold Making by Electroforming

Electroforming can be used to make intricate molds that are reproducible and have interior finishes that do not require any further polishing.

S. FIALKOFF, *Vice President*
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In these days of high mold costs and the increasing complexity of molded plastic parts, it is of major importance that every plastics engineer or technician understand and be able to evaluate any new process that may help to solve the difficult problems posed by molds not readily handled by routine mold making methods.

One of the most recent of these new developments is the electroforming process of making plastics molds. Like many other special techniques, this process made rapid development strides during the war, and has found many applications in the production of both civilian and military items. Radar wave guides, ordnance shell components, fountain pen and razor parts, and phonograph record masters are only a few of the fields in which electroforming has proved advantageous.

In addition to making dies and molds for plastics, electroforming can be used for the production of metal parts, especially those of tubular, conical, or cup-like shape, more economically than by deep-drawing or other operations involving more than a simple swedging or stamping. By forming the part directly to the desired shape, secondary operations, such as punching, milling, and annealing, are eliminated.

The Electroforming Process

Fundamentally, the electroforming process uses the sample principles and methods as electroplating. Whereas the latter method is concerned mainly with the production of attractive surface finishes or corrosion-resistant exterior coatings, electroforming involves the electrodeposition of a relatively thick layer of metal on a master mandrel and the subsequent removal of the plated shell from the mandrel so that a self-supporting part or formed article, not a mere coating, is produced.

A fairly large number of metals can be electroformed; the most common being nickel, copper, iron, and silver. Other metals which may be electroformed include lead, tin, cadmium, zinc, cobalt, indium, and chromium. Nickel is the preferred metal for making plastics molding cavities because of its hardness, resistance to tarnishing and rapid rate of deposition.

By using a Watts bath at 150° F., with modified operation techniques, and a current density between 200-250 amperes per square foot, we can plate nickel at a thickness rate of 0.010 inch per hour. Actually, a plating rate of at least twice this speed is possible, but is used only for forming molds or pieces in which only the internal surfaces next to the mandrel are critical. However, general forming at a thickness rate of more than 0.010 inch per hour is unsuccessful with economically practicable bath agitation because the external surfaces tend to develop ripples and other irregularities.

A master mandrel is the primary requirement for the production of cavities for plastics. This mandrel may be made of a number of materials. Where a large number of cavities is required, this mandrel should be made of a hardened tool steel that is highly polished and free from tool marks, scratches, or other imperfections. Hardness is needed merely to serve as a protection against damage owing to handling during the production cycle. The mandrel is not subjected to hobbing, heat, or other stresses, as is the case with beryllium

copper castings.

For making pilot models or a small number of cavities, the master mandrel may be of soft steel, brass, or even, plastic. High-temperature acrylic plastic or any of the thermosetting materials may be employed for this purpose.

One or two master mandrels will produce an unlimited number of cavities without the slightest damage to the mandrel. Since each electroformed cavity exactly reproduces the surface finish of the master mandrel, it is very important that the master have a finish that will be acceptable on the molded parts.

After suitable mounting and preparation, the mandrel is immersed in a nickel bath and becomes the cathode. After a deposit of pure nickel to a thickness of about one-quarter inch has been attained, the solid nickel shell is stripped from the mandrel which is then used for the next cavity. A drawing of the mandrel and electrolyte is shown in Figure 1.

During the electroforming cycle, the plating solution is circulated very rapidly, and filtered constantly to remove impurities. Temperature of the bath, pH, current density, and electrolytic purification are controlled automatically during the production operation. A typical production set-up is shown in Figure 2.

The electroforming of plastics mold cavities is performed in two phases. First, a layer of hard nickel (with a Rockwell "C" hardness of 40-50) is deposited in contact with the master mandrel to provide the hard inner surface of the cavity. This layer is usually about 0.125 inch in thickness, but the thickness may be varied for specific applications. Second, a back-up layer of regular nickel (with a Rockwell "B" hardness of 90) is deposited to bring the cavity to final size.

At the completion of the electroforming operation, enough nickel has been deposited to permit turning the cavity down to desired exterior size. In addition, the cavity is usually made about one-quarter inch oversize to permit trimming to length. A cavity "as electroformed" and after machining for insertion into a mold is shown in Figure 3.

The mandrels can be mounted on an endless conveyor which rotates the mandrels as it moves them through the bath. Plating time and thickness of deposit are controlled by adjusting the speed of the conveyor.

For comparatively simple shapes involving no undercuts, a thin layer of a parting medium is applied to the mandrel to permit ready separation from the plated form. Parting agents such as beeswax, carbon black, collodion, turpentine, and others allow plating over the mandrel, but prevent the formation of a strong bond between the mandrel and plated metal. For complicated parts that contain undercuts, fusible mandrels made of a bismuth-lead eutectic alloy are used. These mandrels are centrifugally cast in the desired shape. After the part has been formed, the mandrel is melted out in a hot oil bath. The alloy is recovered and recast for further use.

With permanent mandrels, tolerance of ± 0.0005 inch are no problem since the mandrel can be machined and ground to desired size. Thickness and outside tolerances of the formed part are controlled by adjusting the plating bath. Tolerances of ±0.001 inch on external dimensions

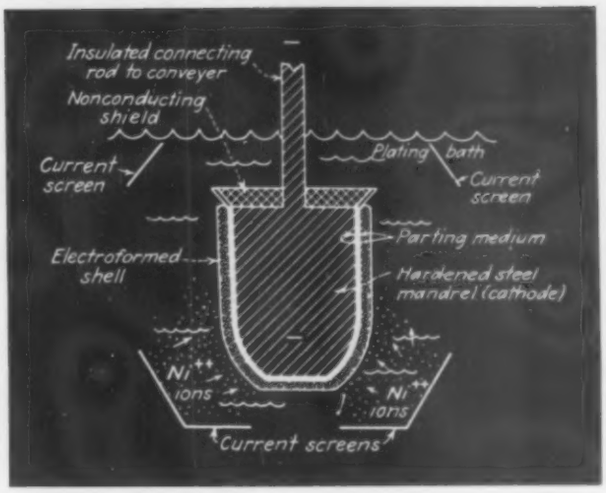

Fig. 1. Diagram of electroforming a shell over a mandrel

are easily held in production. Tight tolerances are also possible with fusible mandrels if properly cast and machined. In general production work, tolerances of ±0.002 inch are usually maintained when using fusible mandrels so as to avoid the time and expense required by greater precision.

Advantages and Applications

Owing to the interesting advantages of the electroforming process, a wide range of applications has already been developed. These advantages or features of the process include the obtaining of cavities having beautiful interior finishes; reproducibility of cavities; no damage to the master mandrel; cavities have hardened interior surfaces obtained without the use of heat; and perfectly-matched cavity halves obtained without irregular parting lines.

Since the electroformed cavity exactly reproduces the finish of the mandrel, mirror-finish cavities that do not require any hand polishing can be made by simply controlling the finish on the master mandrel. This offers very great attraction to the maker of pen and pencil barrel molds where polishing of cavity interiors

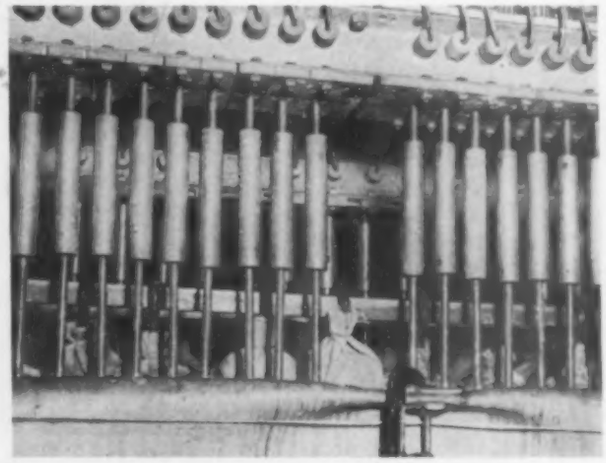

Fig. 2. Close-up view of production plating tank shows mandrels held in chucks.

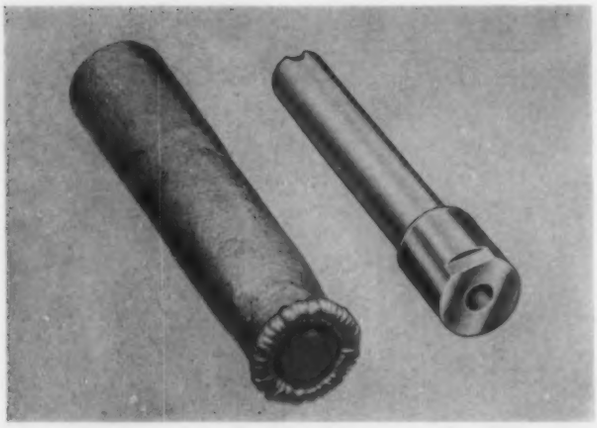

Fig. 3. A cavity "as electroformed" (left) and after machining (right)

is very difficult and costly, and offers the risk of varying cavity size.

All cavities made from the same master mandrel are completely identical and reproduce the exact size of the master. Thus, electroforming offers an excellent method for making cavities of high precision. One application where this is of great importance is the making of molded nylon gears (see Figure 4). Controlled pitch diameters are very critical in such cavities, and hobbing often cannot be depended on to produce the desired dimensional tolerances. Another application is the making of deep cavities, such as for pen barrels, which are not easily obtained with other mold making methods.

Since the master mandrel is merely immersed in a slightly warm solution (the plating bath) and is not subjected to heat or stress, there is no danger of cracking or distorting the master. It should be noted that masters often are the result of long hours of hand work and are almost impossible to replace. Electroforming thus safeguards the master mandrel.

The electroforming process makes the cavity follow the contours of the master. Therefore, the length of the cavity and its exterior size and shape are of little consequence. Deep octagon-shaped pencil barrel cavities (see Figure 5), tapered medicine droppers, and compound gears are some of the applications which are attained easily by this process, but would represent major problems when made by other means.

Unusual surface finishes and designs may be reproduced by electroforming. If a satin or "two-tone" finish appears on the master, it will be copied automatically in each cavity. Reproductions of a leather finish or of diamond facets (see Figure 6) are no problems to electroforming.

Cavities produced by electroforming have interior surfaces that are hardened without the use of heat to a greater depth than could be obtained by heat-treating steel. This required hardness is achieved by the use of addition agents in the electrolyte. Consequently, the process eliminates the danger of cracking, distortion, or discoloration presented by heat-treating.

A method has been developed for making two perfectly matched cavity halves of hard nickel by the electroforming process, starting with an initial wax master. Expensive machining, blueing, and hand-matching of cavity halves are eliminated by this method.

Conclusions

The development of the electroforming process offers new possibilities for the design of plastic parts; an easier method of achieving results that previously were either uneconomical or impossible; and an improved quality of tooling to meet today's size and fine finish requirements.

The process is not intended to completely replace such conventional methods as hobbing for making cavities. Where cavity shapes are such that they may be hobbed easily, that method is still the cheapest and most desirable to use. In addition, cavities with heavy wall thicknesses needed to make very large items are not ideally suited to electroforming. However, where the ease of making a wax or plastic master can be com-

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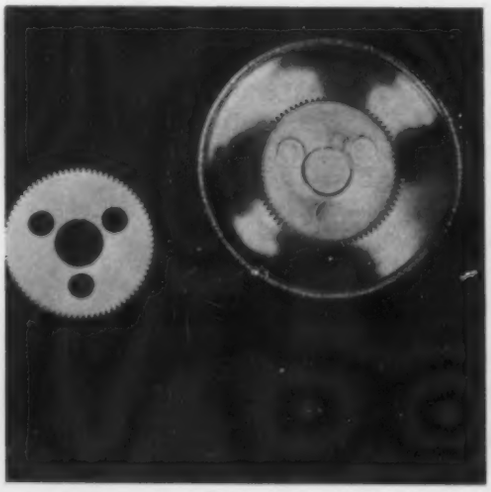

Fig. 4. Nylon gear (left) is molded in electroformed cavity (right)

Fig. 5. Pencil barrel (left) is molded in deep electroformed cavity (right)

Fully Automatic Molding

Automatic compression and injection molding machines, their features and limitations, with emphasis on feeding and injection mechanisms.

QUENTON M. WHITE, *Manager of Plastics Division*
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It has been extremely interesting to watch the growth of automation during the past year. I believe the major growth has been in the form of new ideas and research and development, rather than any great growth in the use of radically new equipment. Obviously, this use of new equipment will follow in the next few years. However, the promotion of this "new idea" thinking and the dramatization of the word "automation" has expanded the use of commercially available automatic machinery. Thus, available automatic equipment is being considered in a different light because of the new automation movement.

Fully automatic molding in its present form is not new, and originated in Philadelphia approximately 20 years ago. The basic economic incentive that spurred the invention of fully automatic compression molding equipment is still an important consideration today. This incentive is the reduction of direct labor costs and lowering of the mold investment. There is a continual juggling of mold cost and productive labor cost in order to get a balance that affords the lowest piece price.

On semi-automatic equipment, low mold cost means high labor cost per piece. In order to get low labor cost per piece, however, a high mold investment is required. Obviously, if very large production is required, a large mold can be built and gives low labor cost per piece. Also, in view of the large production, the mold amortization rate would not be excessive. In the early days of the plastics industry, such very high production jobs were few and far between. Therefore, a small 10-ton automatic press was designed and utilized a single cavity mold (with attendant low mold costs). Since the only labor required was to fill the hopper with raw material and remove the parts in bulk, low labor costs also resulted.

As larger production requirements arose, larger automatics with increased efficiency expanded the production limits within which automatic molding is the most economical method. Even though current production requirements exceed the requirements of 20 years ago, the rate of part obsolescence has increased. Instead of a part being used for several years, today's "model a year" trend means high die amortization per piece.

Although automatic compression and injection molding are based on the same economic principles, obviously the techniques and the importance of the different economic factors differs in the case of each. Therefore, it is logical to break down this discussion into automatic compression molding and automatic injection molding at this point.

Automatic Compression Molding

There are five basic factors to be considered in automatic compression molding, as follows:

(1) Production requirements.
(2) Equipment cost.
(3) Mold cost.
(4) Cycle time.
(5) Efficiency.

The production requirement obviously is the determining factor in deciding whether automatic or semi-automatic molding will be used. On one hand, extremely small productions runs will not justify the expenditure for automatic equipment, and can be molded in a simple hand press. On the other extreme, very large production requirements justify use of an extremely large mold and a semi-automatic press with preheating. In between these two limits, there is a vast range in which automatic molding, with its low mold cost and low labor cost, is the best molding method. Auto-

matic presses cost more than semi-automatic presses, but the preheaters and preform capacity required for semi-automatic operations tend to equalize this disparity.

Mold cost is an extremely important factor since it is rising continually, and the obsolescence factor is becoming increasingly important. In the range of production where automatic molding is suitable, the mold cost necessary to produce the part at a given production cost is lower than for semi-automatic equipment. The cycle time on automatic equipment is normally longer than that of semi-automatic equipment. While the automatic machine can feed and eject faster than an operator can, the use of preheating shortens the semi-automatic cycle. The efficiency of the automatic machine is normally from 10-20% higher than that of a semi-automatic unit because of operator inconsistency with the latter. This somewhat reduces the actual production difference between semi-automatic and fully automatic equipment.

Automatic Compression Presses:

A brief summary of the development of automatic compression equipment may help in evaluating current equipment. The first machines were of 10-ton capacity and were mechanically actuated. A single-cavity feed device, and then, a three-cavity feeder were developed for these machines. This feed device consisted of a rotating cylinder in which drilled holes and adjustable bottoms were installed. This mechanism measured the material and threaded feed tubes into the cavity. Feeding was limited to one row of cavities running left to right across the bed of the press.

The ejection system consisted of an air blow-off which was equipped later with a pushing device to both mechanically knock and blow the parts from the die area. Since these parts had a tendency to hang on the knock-out pins or be trapped by knock-out pins further back in the die, it was necessary to limit the die to a single row of left-to-right cavities. This blow-off was not entirely foolproof, so a trap or weighing device was added to the machine. If all the parts were not ejected, the trap would stop the machine from recycling.

The size of the automatic press was increased throughout the years, but the basic principles remained the same until 1948. At that time, the present concept was introduced and it has been this new line of automatic machines, plus the valuable experience gained in the techniques of automatic molding, that has made this process the important factor it is today in the plastics industry.

The new automatic machines are equipped with a tray-type feed which can feed any number of cavities, either left-to-right or front-to-back, that will fit within the platen and feed areas. A new ejection device (see Figure 1) was introduced which consisted of hydraulically-operated ejector pins and a comb. Since the parts are stripped off the pins in a positive manner, knock-out pins can be buried in the pieces, thus guaranteeing the location of these pieces in the press when the unit is opened. Since the parts are not blown out of the die, but are carried out of the comb, multiple cavity rows front-to-back can be used.

This ejection system has been found to be extremely positive in action, with no need for a weighing device in the circuit. However, a low-pressure closing device has

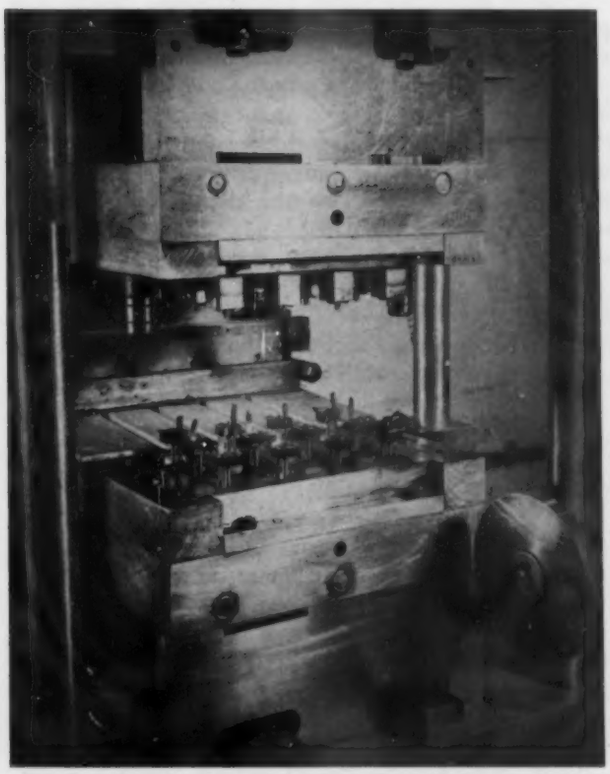

Fig. 1 Photographs showing ejection device on Stokes Model 800 automatic compression molding press
(A) Press opens, and pieces are raised on knock-out pins

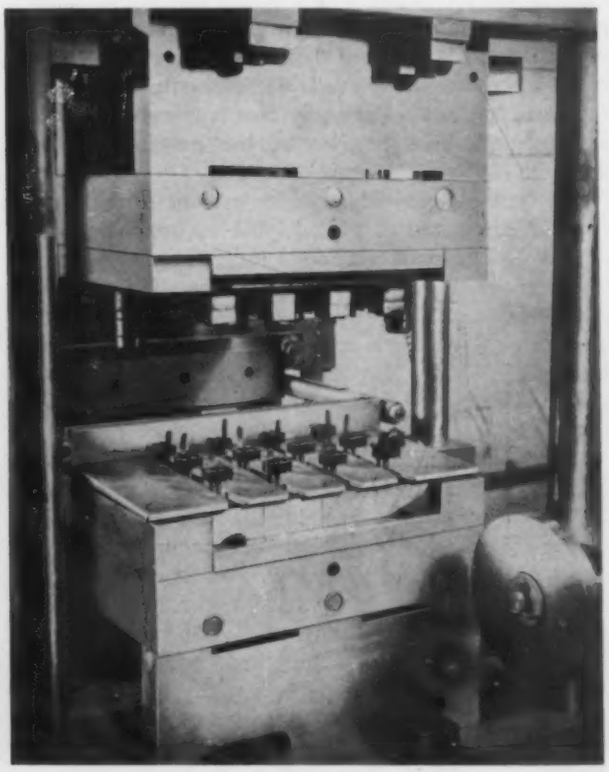

Fig. 1 (B) Comb in ejection position; knock-out pins are ready to withdraw

been installed in case the knock-out pins push through any partially filled parts and leave them in the cavities. It must be remembered, however, that this low-pressure closing device does not make the machine automatic, but is merely an additional safety device to protect the press and the mold in the very infrequent instances where all the parts are not ejected.

The Stokes Model #800 press is a 15-ton unit that is both mechanically and air actuated. This press has multiple rows of cavities both front-to-back and left-to-right. In operation, the knock-out pins are raised first and a slotted steel comb moved in under the parts and around the pins. The pins are then retracted, leaving the parts on this comb or plate which is moved forward to the discharge position. Immediately following this plate, the feed device moves into position over the cavities and a bottom shuttle plate is actuated so as to dump material into the cavities at this time. Both the feed and comb are then returned to their original positions.

Air is used to power the toggle mechanisms which gives extremely fast ram speeds in the clear, and slow pressing where it is needed. A mechanical drum cam actuates the rest of the automatic motions and, since these motions are all governed by cams on the same shaft, overlapping without danger of interference can be accomplished. This combination accounts for the extremely fast cycle time of five seconds that can be obtained on this equipment.

The Model #741 press is a 50-ton straight ram machine that is self-contained and hydraulically actuated. It features the same basic ejection system that is used in the Model #800, but the comb moves in from the front of the press and the feed from the back. The press time is 15 seconds, and sequence operations stop the press if any malfunction takes place. Since ejection is positive, the 15-second cycle time holds true whether the machine is running dry or actually molding. The same tray-type loader is used on this press as in the Model #800.

Larger automatic presses have been considered and built, but there are very few jobs that have the production quantity to justify the increased tool cost. In addition, multiple units of smaller presses have the advantage of flexibility. Larger automatic presses will be used mainly for larger parts. Since these larger parts normally have heavier sections, preheating will be required to allow automatic molding to compete with semi-automatic compression molding in these cases.

Limitations

As in other phases of the plastics industry, many of the basic problems of automatic compression molding stem from misapplications. Proper usage of automatic molding equipment has extended the use of this equipment over the past 20 years, but improper usage has left early users with bad impressions that have kept them from considering present automatic presses with their superior characteristics. Of course as soon as you list limitations, someone recalls a case to disprove your point. In discussing limitations, it must be emphasized that they are not practical on a large commercial scale, not that they cannot be done. It should also be remembered that limitations, which have enough economic incentive will be overcome by tomorrow's improved production techniques.

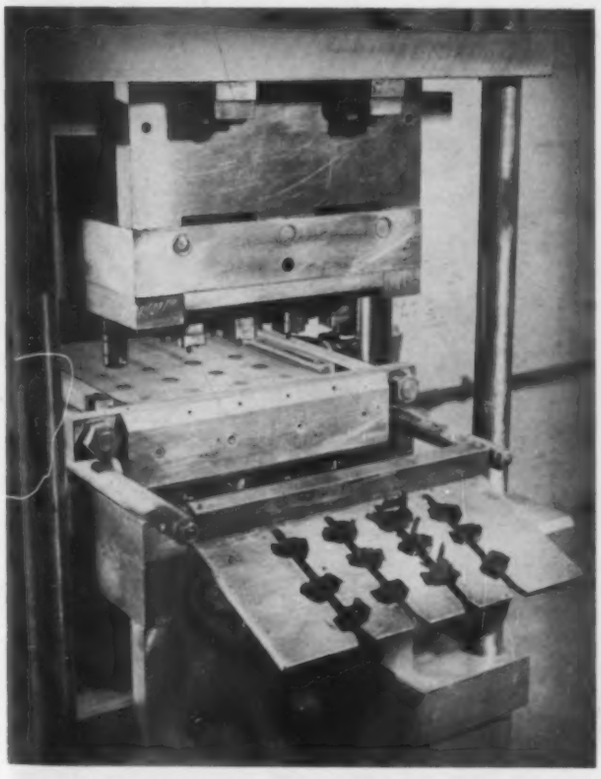

Fig. 1 (C) Comb discharges pieces as shuttle approaches feeding position over cavities.

Fig. 1 (D) Comb and shuttle feed have returned, and press is closing to start another cycle

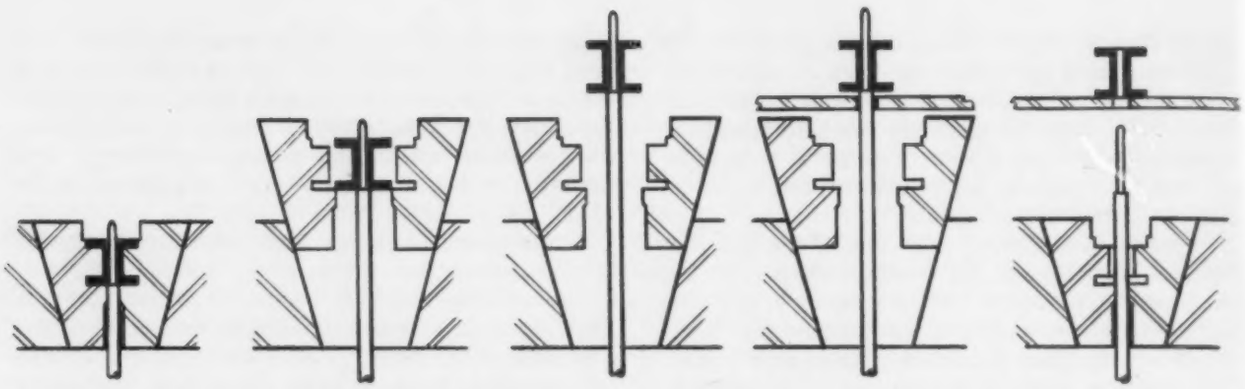

Fig. 2 Automatic compression molding of coil forms on a split-cavity mold: (*left to right*). Mold opens; Cavity blocks and pins move up by standard ejector; Block movement stops, and pins advance further by special secondary ejector; Comb moves in; and cavity blocks return and pins return same amount as blocks thereby stripping pieces.

The handling of impact materials having a bulk factor greater than approximately 2.7 or 2.8 has always presented a problem in automatic molding. The material will not flow in the feed tubes, resulting in non-uniform fills. However, some of the higher impact nodular materials have been handled successfully. In feed tubes approximately ½-¾ inch in size, nodular material with bulk factors of approximately 3.5 have been run successfully.

The automatic loading of inserts has presented another problem because of the need for positive positioning of the insert in the die. It is obvious that any mislocation of the insert will produce imperfect parts and/or cause serious damage to the die. Also, it is extremely difficult to obtain mass-produced inserts with close enough tolerances to assure every insert being able to fit into its proper location without being so loose that flash will creep in. In almost every insert molding operation, the operator removes a few of the inserts and puts them aside because they will not fit.

The only way to eliminate this problem in automatic molding is to automatically size and measure the inserts, and machinery to do this is extremely expensive. Again, very few molds have a production run long enough to justify not only the sizing equipment, but the special insert-loading equipment which also must be designed for each individual job. The trend has definitely been toward automatic molding with automatic insertion of the inserts at a later time. Obviously, this will not work in every case and these jobs must be molded semi-automatically.

As in any compression molding operation, the ratio of

Fig.3 Photographs showing ejection of pieces from a Stokes four-ounce automatic injection machine
(A) Press opens fully, showing molded pieces in cavities

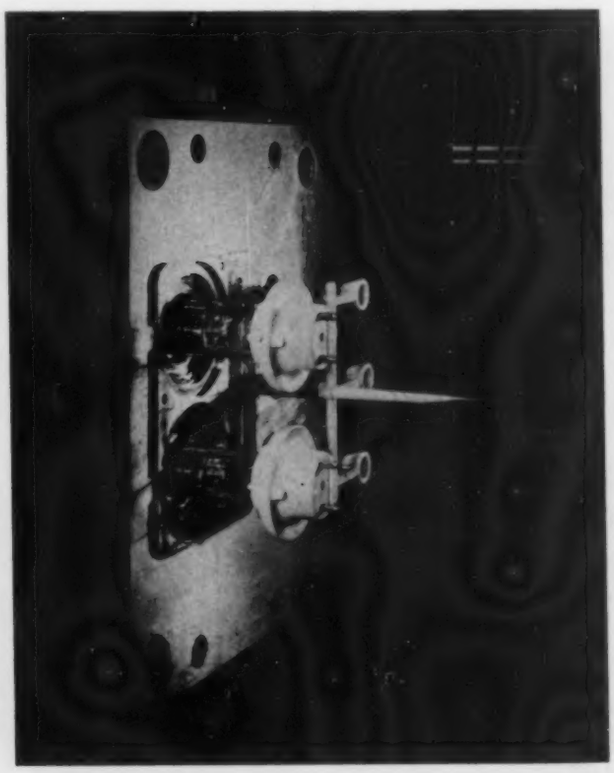

Fig. 3 (B) Pieces and runner system ejected positively by hydraulic knock-out pins. De-gating has been accomplished during the ejection stroke

pin length to diameter is an extremely important factor. However, with automatic molding and the consistency of automatic cycles, unusual pin lengths have been molded, but normally a pin ratio of 2.5:1 is the maximum.

Side draw parts are not normally acceptable for fully automatic molding. Some parts having mechanically-pulled side draws, others with air cylinder-actuated side draws, and some split-cavity molds have been produced, but these are the exceptions which prove the rule. It must be clearly understood that, except for the split cavity mold, there is no guarantee that the side draw returns completely to its original position.

Maintenance on the cams of mechanically-actuated units must be considered. Tolerances on the depth of the hole cored by an air-operated cylinder must be such that a microswitch measuring the position of the air cylinder is sufficiently sensitive. On the split-cavity mold, the design is made so that any slight separation of the split cavities is considerably multiplied so that a microswitch type sensitive device can be completely accurate.

New Developments

There are many machines and devices which are developed for one particular customer's requirements, but I would like to briefly discuss the most important new developments within the past six months.

The first of these is the split-cavity mold mentioned previously which permits the molding of parts such as coil forms on an automatic basis (see Figure 2). Since the number of cavities that can be put into a semi-automatic molding machine of large cacapcity is limited because of the side draw motion, automatic molding becomes very attractive in such a case. On most of these items, the cure time also is relatively short, which again lends itself to automatic molding.

The second item is a rope feeder which will handle glass-filled polyester rope materials. This device can be attached to a standard #741 press and measures, chops, and feeds the proper rope slugs into the standard feeder on the machine so that the cycle can be carried out in the conventional manner. This new feeder appears to hold promise for those companies desiring high electrical arc resistance and good impact strength in their moldings.

Automatic preheating has made some wonderful advances in the past 18 months, and commercial units are now available for preheating powder to be used in conjunction with automatic molding presses. Obviously, this development has great potential for expanding the use of automatic presses in molding heavier section parts which normally are transfer molded.

Automatic Injection Molding

In injection molding, there are four main economic factors to be considered, as follows:

(1) Production requirements.
(2) Equipment cost.
(3) Mold cost.
(4) Efficiency of the operator.

In the case of injection molding, high production runs do not make automatic molding uneconomical. Since no advantages in cycle time is afforded by semi-automatic molding, automatic presses will produce

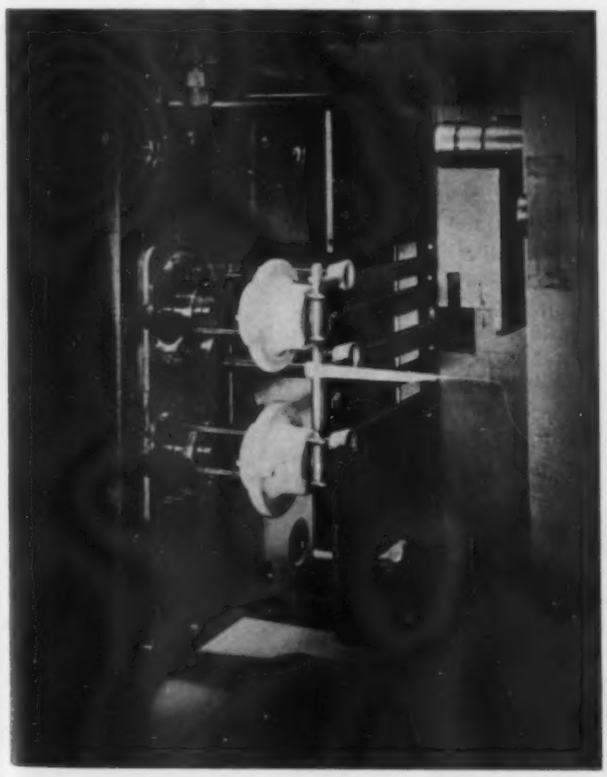

Fig. 3 (C) Pieces remain in fully-ejected position as comb starts across mold face

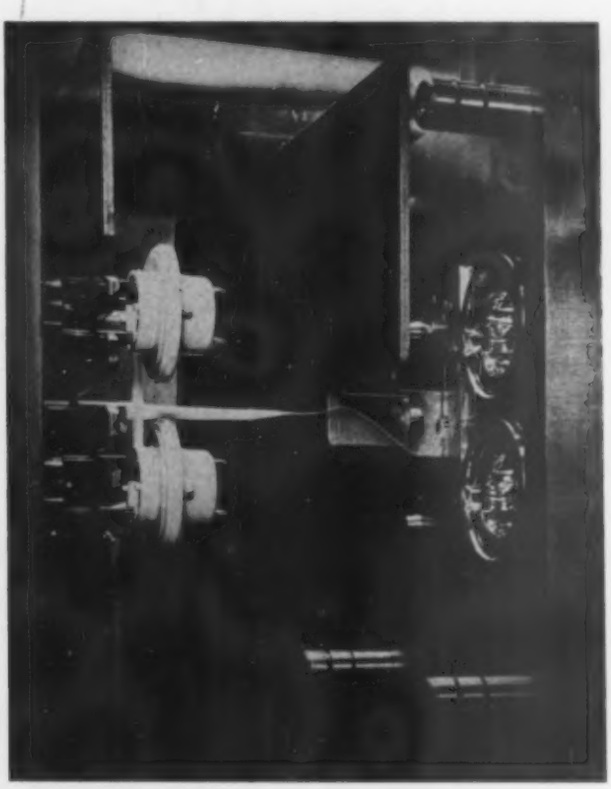

Fig. 3 (D) Comb has nearly completed its travel. Knife blade has been positioned on stationary mold face so as to shear the sprue thread

cheaper parts. Other factors, however, limit the use of large automatic presses. The most important of these is that large machines are usually needed for large parts instead of a very large number of smaller parts. These large parts must be handled carefully and cannot be ejected from an automatic press without damage.

The automatic injection machine costs very little more than a standard semi-automatic press. In fact, in many cases semi-automatic machines are more costly since they must be built to operate at very high speeds in order to best utilize the operator running the machine. Molds for machines equipped with automatic features for positive ejection and degating cost very little more and sometimes less than molds for semi-automatic machines. The efficiency of automatic machines is obviously higher than that of semi-automatic machines due to the elimination of operator inconsistency.

Equipment

Injection molding machines have always delivered material automatically to the mold. Therefore, the only difference between an automatic and semi-automatic press is in the ejection means. For years, press manufacturers and users have used dropping arms and air to remove the molded parts from flush knock-out pins and stripper plates. However, much of the advantage of automatic operation was lost since the parts had to be degated manually. Also, many parts could not be hit with an arm and the flash around the pins prevented the use of air for ejection.

Dies with automatic gate shears have been built, but are generally expensive and complicated which, in turn, means that they are somewhat unreliable. Tunnel gating has been used with some success, but the gates on some of the parts tend to break before the others, and the runners shift and hang in the gate rather than be ejected. This stops the press frequently, provided that the press is equipped with a low-pressure closing device. If the presses are not equipped with this device, damage to the mold can result.

The newest Stokes injection presses utilize the same basic ejection system as our automatic compression presses. This provides the foolproof operation required for economical automatic molding on a variety of parts. (As shown in the series of photographs of Figure 3), the mold first opens, and then the hydraulic ejectors are moved forward. A comb moves in behind the parts and around the pins. Simultaneously, a knife blade and protective plate move in to cut any thread that may be pulled from the nozzle and cover the cavities. Then, the pins are retracted, thus combing off the parts and letting them and the sprues and runners drop into the chute. This combing action allows pins to be buried in the parts and in the sprues and runners, and results in positive location of the part, sprue, and runner during the opening of the machine. The combining action also allows degating. Two or three-place molds with knock-out pins or stripper plates can be run, and positive ejection, usually as well as separation of the sprues and runners from the parts, is provided.

One of the advantages of having this automatic equipment as part of the machine is the simplicity of the molds that can be used. This feature appeals very much to the customer molder who may run many different parts on the same machine during the year and cannot afford to set up complicated self-degating

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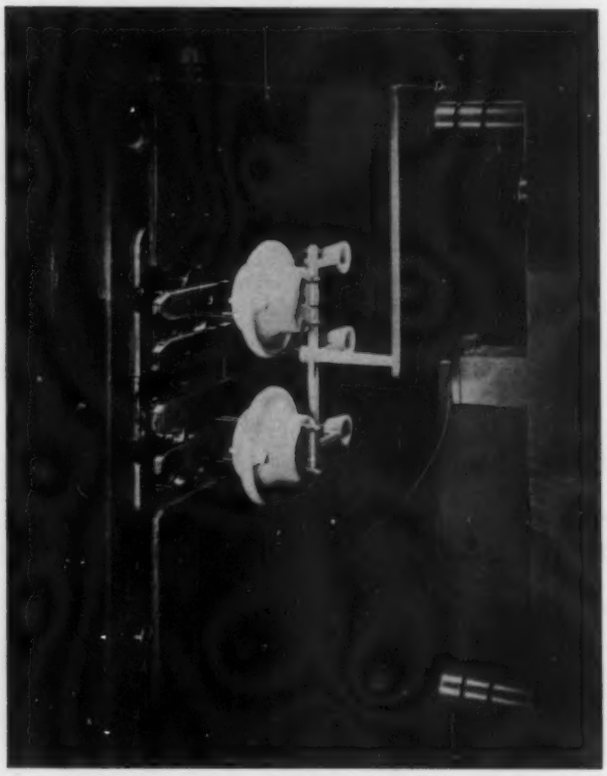

Fig. 3 (E) Thread has been cut. Comb is positioned behind the pieces

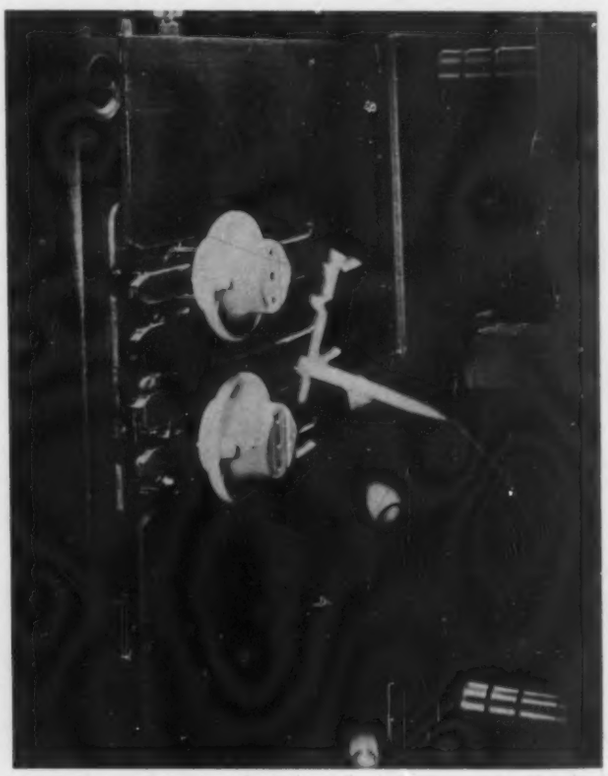

Fig 3 (F) Pins are retracting and pieces start falling into a chute

Guest Editorial

Photo by Stanley Gerard Mason

The Industry's Stake In Vacuum Forming

SANFORD S. ZIMMERMAN, *General Manager*
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Despite its magnitude in reaching the billion-dollar brackets of big business, the plastics industry remains one of the closest knit of all American industries, with each segment dependent to some degree on the other segments.

By that I do not mean merely the fact that the plastics field is wide in scope, with a diversity of materials and processes that exhibit an overlapping relationship in their uses and functions. I also have in mind the fact that, despite its substantial achievements and its contributions to progress, our great industry has had to wage an uphill fight to gain acceptance. We have had to overcome conservative inertia and actual prejudice against new materials, new products, and new ways of creating familiar products, even though these have brought about measurable gains in quality, manufacturing efficiency, and economy. We have had to overcome the misconception that plastics are merely substitutes for older materials; often "cheap" and perhaps inferior substitutes. We have had to combat unfounded fears that plastics compete unfairly with other products and processes, and hack away at ignorance about plastics and their proper applications.

Our industry has been acutely aware of these problems, and much has been done to clear the air and bring about a wider realization of the advantages of plastics. Plastics now stand high in the regard of most industrial and consumer users, yet there are still some areas where further strides remain to be taken. In the household, decorative, and architectural fields, some people still tend to think of plastics in terms of certain drawbacks that no longer exist. Industrially, such as in the plastics tooling sphere, some resistance still remains among the artisans using long-established, conventional techniques and materials.

Even with the high level of acceptance that has been attained for plastics, there is always the danger of a retrogression, and it is to the interest of all elements of the industry to avoid this insofar as possible. Just one single misappliction of plastics can do untold harm by blackening the reputation of all plastics.

It is for this reason that I am convinced that it is of extreme importance for all sections of the plastics industry to become conversant with new materials and new processes as they come along—to investigate them, give them a fair trial, and then confer either rejection or acceptance.

Vacuum forming is a comparative newcomer among plastics production methods, and it has had a startlingly rapid and successful surge to the forefront. It is noteworthy, however, that this progress has been attained largely through the efforts of companies and individuals outside the "plastics family." It is only in the last year or so that interest and use have become widespread among concerns well within the industry.

In a sense, it is a tribute to vacuum forming that so many organizations with a limited knowledge of plastics and a limited experience in handling them became so quickly and enthusiastically convinced of the benefits that could be gained by using this comparatively easy and efficient technique to produce superior packaging, displays,

(*Continued on page 555*)

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Are Tool Plastic Standards Needed?*

An examination of plastic tool materials and applications shows the need for establishment of engineering standards.

A casual examination of the tooling used for sheet metal forming; plastics laminating, post-forming, and casting; various assembly tools; certain types of foundry patterns; master models; and duplicating models will reveal that plastic tooling is in wide use today. When we consider the relatively short period of time that has been devoted to the development of plastic tooling as compared to its metal counterpart, it is not surprising that a certain amount of confusion, misinformation, and misapplication of plastic tooling exists.

The manufacturers who supply plastic tooling materials to industry have attempted to provide information regarding their particular materials and the application of them. Also, tool engineers located in the plastic tooling users' plants have done a great deal of independent thinking and experimenting. This is the normal pattern we in the tooling industry encounter when working with new materials and methods. In the case of plastic tools, both the materials and the methods were relatively unknown until recent years. Information has been obtained, however, from every tool that has been built, disregarding the degree of success of that particular tool. Unfortunately, at the present time there is no organized method of analyzing and distributing this data.

The majority of manufacturers using plastic tooling have been extremely cooperative in providing the information that has been necessary to develop plastic tool materials. In fact, their liberal attitude has contributed in a large measure to the rapid progress of this type of tooling. Plastic tooling has proven its usefulness to the extent that if all information acquired in the practical manner previously described was properly correlated with the laboratory data, we could undoubtedly do a much better job of placing plastic tooling in its proper perspective.

We could make an excellent start toward the development and publication of plastic tooling standards which would provide, in general, the following information:

(1) Physical properties data which would permit the selection of the proper tool plastic material or materials for a given job.

(2) Handling procedures data on the tool plastic materials so selected to insure proper processing of the tool under construction.

(3) Design data that would enable the tool engineer to ensure uses of the correct tool design for the job at hand.

(4) Proper operating procedures for use when running plastic tooling.

(5) Storage and maintenance procedures required for plastic tooling in order to secure maximum tool life.

It is obvious that such a standardization program would require the cooperative effort of many organizations. Therefore, in all probability it is a task best undertaken by the established engineering societies either working individually or, better still, as an organized group.

Any standardization program involving several industries is by its very nature the type of project that requires an extended period of time to complete. In fact, it is

* Presented before the American Society of Tool Engineers, Los Angeles, Calif., March 15, 1955.

doubtful that any standardization program is ever entirely completed as long as the materials and process under consideration are in general use. Therefore, we can consider the information currently available.

Plastic tooling in its broad application has not changed the basic tooling principals in use by industry. In fact, it is merely the application of specialized types of plastic materials to the manufacture of tooling. The only changes that have been made are those required by the physical properties of the plastic material being used. This frequently involves supporting metal frames, bases, metal inserts at points of severe service, etc.; all of which can generally be accomplished by minor changes in the design principals normally used for a given tool.

Types of Plastic Tools

A brief study of the types of tooling in general use and the materials used to make them will help provide the information necessary in selecting a tool plastic material.

Stretch Dies

Stretch dies (see Figure 1) have been successfully made for several years utilizing phenolic materials mounted on a steel base. This type of tooling is well established. There is a great deal of data available which proves beyond doubt that phenolic stretch dies are practical and successful. Recently, however, a considerable number of these tools have been made utilizing fiber glass laminated with epoxy resins as a working face. Both new types have been successful and, therefore, standards should be developed covering this entire class of tooling.

Draw Dies

A great many phenolic draw dies have been built. The majority of these tools were successful and established the fact that plastic tooling in this field is a marked improvement over the all-metal tool where production requirements, the particular configuration involved, and the material being drawn are such that a plastic tool is more practical. With the advent of the epoxy materials, it was found that by using a metal core either of ferrous or zinc alloy material and capping it with a working face of epoxy, a satisfactory tool could be built and, in some cases, at a lower cost. This type of tooling is being used by the automatic and aircraft industries with considerable success (see Figure 2). If tool standards were available in this field, many industries would be able to profit by plastic draw die data accumulated to date.

Hydropress (Rubber-Forming) Dies

While a number of phenolic tools of this type have been made successfully, the condition of much of the press equipment used for this type of work is such that it imposed severe strains on the phenolic tools. It was necessary to apply heavy steel bases to the presses in order to make them work. Combinations of cast and laminated epoxy have eliminated these difficulties to a certain extent, and today provide an economical means of manufacturing these tools (see Figure 3).

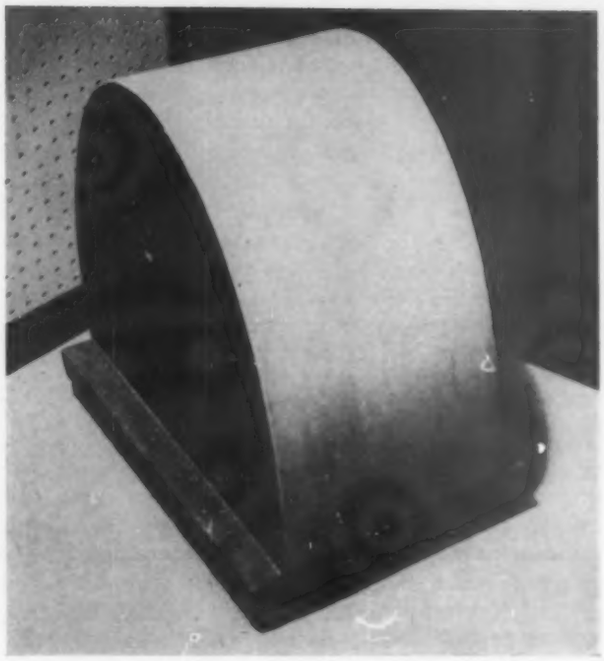


Fig. 1. Plastic stretch die has metal base, phenolic core, and epoxy laminate working face

Drop Hammer Dies

Drop hammer dies have been successfully made of thermoplastic materials which are primarily ethyl cellulose compounds and, in some cases, of epoxy materials which possess a high degree of flexure. Tools of this type eliminate the need for the customary metal clearance between the punch and the die. Standards for this type of tooling would answer many of the questions being asked by industry.

Laminating Molds

Laminating molds have been made successfully of

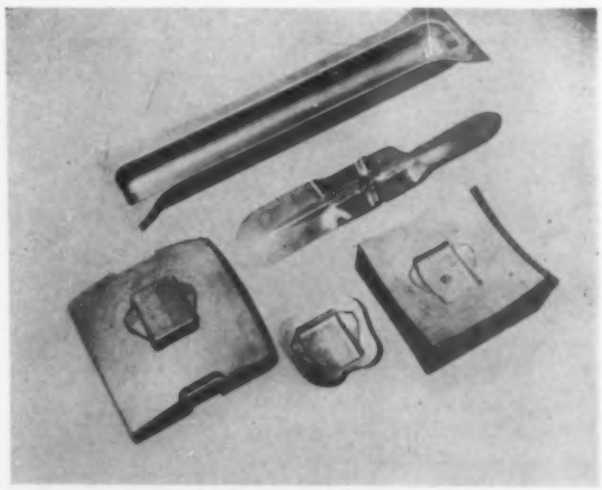


Fig. 2 Plastic draw die has gray iron core with cast epoxy working faces on die cavity and binder ring. Punch is solid epoxy casting. Stamping made on this die is in foreground. Two other typical stampings are shown in background

phenolic materials for a number of years. In general, these tools utilize the thin-shelled process which primarily consists of a steel basket type structure on which a phenolic working face is cast to minimum thickness (see Figure 4). This type of tooling proved successful in the fabrication of an entire automobile body, and has long been used by the aircraft industry in the manufacture of radomes and other laminated parts.

Epoxy materials have been used to manufacture laminating molds. However, their low heat distortion points restrict their use to low temperature cures. Recent work on the development of epoxy materials with higher heat distortion points may alleviate this problem.

Post-Forming Tools

With the rapid development of the vacuum forming process, a new type of plastic tooling has come into general use. For the most part, these tools have been made of phenolic. They consist, in general, of a male plug over which the preheated material being formed is draped. Vacuum pressure is then applied, and the formed part allowed to cool in place. Again, the low heat distortion points of presently available epoxy materials restrict their use for this type of tooling.

Assembly Tooling

Tool plastic materials have been utilized in assembly tooling in two principal manners: as a cast or laminated component part which usually forms a locating block or pad, generally with considerable contour on its working face; and as a potting material to provide precision location of the components of the assembly jig without resorting to extensive machining. Epoxy materials are used almost exclusively in this field.

Trim and Drill Fixtures

Here, again, tooling is almost always made of epoxy, generally an epoxy laminate (see Figure 5). In some cases, however, phenolic nests are used to support the material being worked.

Master Models

High precision master models may be made from either phenolic or epoxy materials. If excessive handwork is contemplated on the model after casting, phenolic is generally used because it is somewhat easier to sand or scrape to a given contour. Epoxy, in either laminated or cast form, generally produces a somewhat lighter tool than phenolic. In both cases, the tool must be supported by an adequate structure.

Duplicating Models

Many duplicating models have been made successfully of phenolic materials. Recently, however, epoxy-glass cloth laminates are coming into more general use for this purpose. In either case, the smooth working surface obtainable with plastic tools reduces stylus vibration on the duplicating machine to a minimum.

The aforementioned types of tooling make it obvious that accurate standards will greatly simplify the problems faced by the tool engineer while designing and manufacturing plastic tooling.

Selection of a Tool Plastic Material

The selection of a material from which to manufacture plastic tooling depends to a certain extent on the tool shop facilities available. In the case of phenolic, curing ovens are sometimes required in order to develop the physical properties needed, but this material can be cured at room temperature. In the case of epoxy resins, the majority are room-temperature cured which, of course, reduces the amount of specialized equipment that is needed.

While the costs of raw materials must be considered, they usually represent only a small percentage of the total cost of the tool. Therefore, it would be most unwise to permit materials costs to jeopardize the successful conclusion of a tooling project. Phenolic materials are the cheapest of the tool plastics in general use today, and in a good application can be used to a decided advantage. The epoxies, while probably the most expensive of all tool plastic materials, are also probably the simplest to use. In computing cost, the

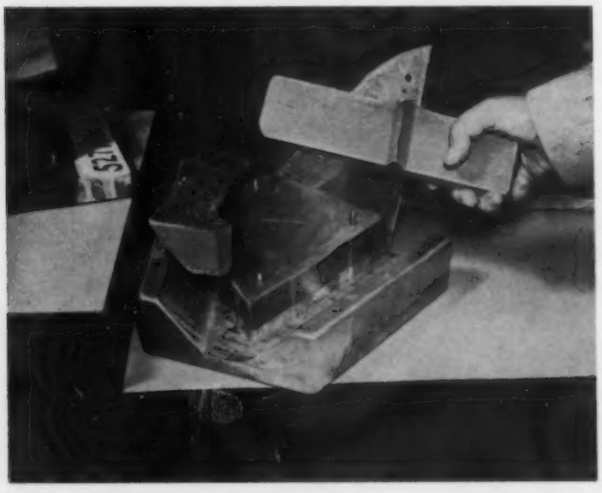


Fig. 3. Hydropress form die has metal blank, rubber pad, and cast epoxy wedge blocks

Fig. 4. Phenolic laminating mold for automotive part is made by shell molding

overall picture must be examined, not just a segment of it, or a false answer may be obtained.

The problem of dermatitis cannot be denied, especially with the epoxies. Manufacturers of tool plastic materials have provided safety recommendations which, if followed, will drastically reduce the hazards created by the use of tool plastics. Phenolic materials are examples of the manner in which this hazard may be controlled. Today, the dermatitis hazard in connection with the use of phenolic has almost disappeared.

The storage and transportation handling of plastic tools presents no insurmountable problems. However, tooling of this type must be protected in order to minimize the danger of chipping the working face. Proper standards would go a long way toward reducing this problem.

A study of the physical properties and handling procedures provided by the materials manufacturers will enable the tool engineer to apply the same reasoning he would use in selecting any other tooling material. He is required, however, to have an overall knowledge of plastic tooling materials and their application. This, again, emphasizes the great value of adequate standards.

Quality Control of Plastic Tools

Proper quality control of plastic tool making is the only procedure that provides definite assurance of predictable results. Uncontrolled experimenting in the tool shop frequently leads to unpredictable results, and probably has caused more headaches than any other single factor involved in the manufacture of plastic

(*Continued on page 558*)

Fig. 5. Nesting section of an assembly tool jig is made of glass-laminated epoxy with gel-coat working surface. Channel-type construction used for maximum rigidity

The Industry's Stake in Vacuum Forming

(Continued from page 551)

consumer products, industrial components, and many other items. It is also healthy for the plastics industry when a new process has the effect of bringing new companies into the fold and creating new users for plastics.

On the other hand, it is trite but true that "knowledge is power," and there is no substitute for know-how and experience in making the best use of materials and methods, and exerting control over them to avoid misapplications and insure use of the right plastic and the right production method for every job.

It is encouraging that vacuum forming is increasingly taking hold among people with many years of "savvy" in plastics. The idea is gaining more currency that vacuum forming need not be regarded necessarily as an alternative or competitor to processes such as injection and compression molding, and plastic sheet fabrication methods that have had long-time use, but, instead, can supplement and complement them.

Because of its low investment in machinery, materials, and manpower, vacuum forming can be added easily to the operations of firms that do other types of plastics manufacturing. Its adoption, for instance, allows the molder to offer his customers a better-rounded service, where vacuum forming is selected for those applications where it can do a superior job. In this way, the process not only offers the processor's customers money-saving and profit-making benefits, but also increases the processor's own volume and revenue.

In keeping an eye on vacuum forming, it is well for plastics industry people to be aware of the constant improvements and refinements that are taking place. New developments to watch include the introduction of machines to form larger objects than in the past and for facilitating economical pilot runs; imbedment; the creation of contour containers by forming; and refinements in subsidiary operations such as preprinting, and the finishing of formed sheets. We also look forward to the trimming of the plastic right inside the press, and to forming machines working directly from an extruder instead of relying on processed sheets.

As these advances take place their maximum value will occur from utilization by companies rooted in the plastics industry, even though benefits will accrue to those industries which plastics serve. The gain for our industry will come about not only from using technological skills to enhance the best possible applications for vacuum forming, but also from continuing to develop the production of plastic products that might not have emerged previously, because they could not have been produced competitively.

In summing up—and this applies not only to vacuum forming but to every step forward in plastics production—each advance for part of the industry can and should be converted to an advance for the industry as a whole.

—The End

Diamond–Metal Bonded Tools Cut Hard Reinforced Plastics

The findings of a six-month survey of methods and tools used by the glass-reinforced plastic industry has been made public by Lee H. Barron, president of Dia-Chrome Co., Glendale, Calif.

It was found that the upper-echelon executive has a resigned and surprising attitude toward the problems of the shopmen. He will continue to estimate new jobs on the basis of past performance, despite the closer tolerances required in the industry today. When told by his shop superintendent that a job is difficult, practically impossible with present tooling and equipment, he will suggest that they improvise with the current equipment or find some tools that can do the job. Yet this same executive has a closed mind when it comes to new tools. He claims he has tried everything: diamond tools are an old story, and carbide tools inadequate.

A brief look at some company operations shows that an aircraft company in California uses nine workmen, each with a ¼-inch carbide router bit, for cutting 1/16-inch polyester sections. This operation wears out an average of one carbide bit every half-hour per man, or a total of eighteen router bits per hour. Total cost is approximately $160 per hour for tools alone.

A well-known fabricator of printed circuits actually maintains three employees using hand files and emery cloth to smooth and deburr the edges of copper-clad Epon sheets. Another fabricator was using a ¾-inch router bit to cut three-foot diameter circles of ¾-inch polyester. This operation required from five to seven hours alone.

And so the story goes, from one shop to another. Shop superintendents are trying to produce finished parts and structural shapes in sufficient quantities, and yet maintain the strict tolerances demanded by today's standards. A natural question to ask at this point would be: "How did the industry accomplish its phenomenal growth with such a basic handicap?" It certainly cannot be attributed to the tools, but it can be credited, in a large measure, to the shopmen who had to draw on tools used for grinding steel, saws for cutting concrete, and grit wheels for sharpening, grinding, and polishing steel and aluminum castings. In fact, there isn't one tool used that was designed specifically for working glass-reinforced plastics.

Examining the action of a basic carbide-tipped saw will give an insight to the problem of cutting hard plastics. The saw is tipped with teeth that must extend beyond the face of the blade to obtain clearance. Each tooth, as it comes in contact with the material, strikes the edge as would a miniature hammer and chisel. Since there are minute differences in the spacing and sizes of the teeth, a series of uneven pounding blows is delivered to the edges of the material. These blows produce rough, fractured top and bottom edges. The harder and more brittle the material is, the rougher the edge. Heat produced by this operation sometimes leads to the displacement of a tooth, with resulting danger to the operator.

Where the problem of overcoming the hammer and chisel action of carbide tools would seem to be solved by the substitution of diamond saws, there still left one deficiency. The soft bonding agents required to bond diamond grit to steel made the practical adaptation of diamond saws an expensive and far from efficient solution.

A recent development has enabled the company to produce direct diamond-to-steel bonded tools. The

Fig. 1. Diamond-coated saw is used at Douglas Aircraft (Long Beach) for cutting a honeycomb kick plate. Honeycomb is phenolic-coated paper with fiberglass-reinforced polyester skin

Fig. 2. Diamond-coated saw mounted in a hand router is used at Douglas Aircraft (Long Beach) for cutting ends and edges of 10-foot honeycomb tunnel sections. Honeycomb is phenolic-coated paper with fiberglass-reinforced polyester skin.

bond forms a complete diamond grit surface consisting of thousands of hard, sharp teeth, each one of which is capable of cutting through the hardest glass-reinforced plastics at high speed with very little pressure. This is cutting by abrasive action without the necessity of using water to cool the blade. The rigidity of the steel tool provides the steadiness required for accurate straight-line cutting, and results in a smooth finished edge without fracturing the top or bottom edges of the piece.

The absolute necessity for smooth, pressure-free cutting is well known in sawing honeycomb panels and structures, especially where polyester fiberglass sandwich material is used. One of the major problems is the delamination and separation which occurs when a toothed saw is used. Where aluminum stiffening members are between the plastic sheets and the foamed filler, the bond must be cut without rough surfaces or separations. This operation can be performed without difficulty with a 10- or 12-inch diamond-coated saw on a vibration-free, smooth-running table saw at speeds from 5,000-10,000 surface feet per minute. The higher speeds produce the smoothest cuts. A typical operation is shown in Figure 1.

Curved edges, such as encountered in radomes, cones, and trailing edges of wings and rudders, are easily cut with mounted saws used in high-speed hand grinders. These mounted saws range in diameter from 1½-2½ inches, with shanks to fit any hand grinder or routing tool. Tungsten carbide router bits or rotary files have been, until now, the only tools that could be used for curved or inside diameter cutting. Such a tool, with only ¾-inch of peripheral surface, must cut its full diameter through the material. This removes more stock in dust than a 12-inch carbide-toothed saw. In comparison, a two-inch diamond-coated saw with an edge thickness of 0.080-inch has six inches of peripheral surface, cuts two-thirds less stock, does not slow down rotational speed of the hand tool, and needs no water (see Figure 2). The operator can follow a line or be guided by a jig, and outproduce a carbide bit 10:1. A circle 18-24 inches in diameter can be cut out of a tank head in approximately one minute, yet the saw penetrates through so that at least ¼-inch clears the bottom edge of the material.

For many special operations in flash removal or with formed edges, such as in the printed circuit field and the electronics industry, we have developed special diamond-coated tools, the edge planers. They are one-piece tools, resembling routing bits, that are turned out on a lathe with any desired angle or radius grooves cut into the side or face. Such operations as forming an angle or a radius edge on printed circuit sheets can be done with ease using a two-inch diameter edge planer. Allowing for the coating of diamond grit, specified degrees of angle can be met, and radii finished within 0.002-inch. With this planer mounted in a high-speed drill press or router, the edge of the sheet is passed across the planer once and the formed edge is complete, smooth and burr-free (see Figure 3). Multi-groove edge planers allow the user to form a square, radius, or angular edge without changing tools or stations.

Many shops today lack the high-speed saws and equipment required to realize maximum benefits from the new diamond-to-steel bonded tools. However, diamond-coated tools are already at work on high production runs, and proving that the so-called hard plastics can be cut, planed, and ground as easily as other materials.

—The End

Fig. 3. High speed milling machine at Convair Div., General Dynamics Corp. operates Dia-Chrome mounted and grooved edge planer to give smooth, 60° angle edges to printed circuit plates of ¼-inch thick polyester

Decorating Molded Plastics—Part I.

(Continued from page 541)

a red center on the plastic wheel at the right. Masks and unpainted parts are loaded into cavities on the revolving turntable by an operator at the left. They move around to spraying position under the housing and are held in painting position by an air clamp. Painted parts continue to a second station to the right where they are removed by a second operator.

A somewhat different machine is shown in Figure 5. Small knobs are placed on vertical shafts around a turntable which moves them into spraying position. Two spray guns are arranged to paint both the tops and bottoms of the knobs simultaneously. As the parts approach spraying position, the pulleys at the bottom of the vertical shafts contact a belt which spins the shafts for uniform painting around the knobs.

The machine shown in Figure 6 is more completely automatic, and much more elaborate. It is set up for painting a steer head on toy pistol grips. One person operates two masks painting the right side of the grip, while a second person operates two masks painting the left side. Parts are picked off the conveyor by the operator, pressed into the mask, sprayed automatically, removed from the mask, replaced on the conveyor and carried to the second floor while the parts are drying in transit, and dumped from the conveyor into cartons.

When the masks become loaded with paint, the lever at the left of the working stations is moved and the metal plate supporting the four masks shifts into the housing at the left where the masks are washed automatically. At the same time, a plate holding four clean masks shifts into position from the housing at the right. When these masks have become loaded with paint, the process is reversed by moving the lever at the right.

An even more elaborate automatic machine, capable of spraying two colors simultaneously on the same part, is shown in Figure 7. One operator stands in front of the machine placing parts over the small masks at about table level. When the foot pedal is touched the mask wheel rotates and the part moves forward to make contact with the small clamping device coming down to meet it. These chain-rotated clamps can be seen in the

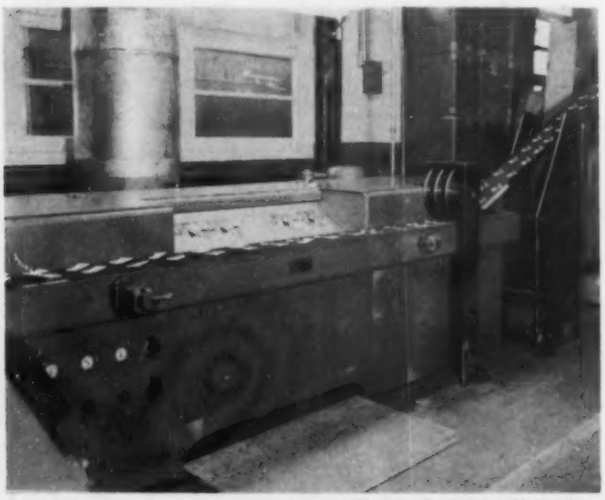


Photo by Conforming Matrix Corp.

Fig. 6. Automatic spray machine with automatic mask washer simultaneously sprays two different plastic parts in duplicate

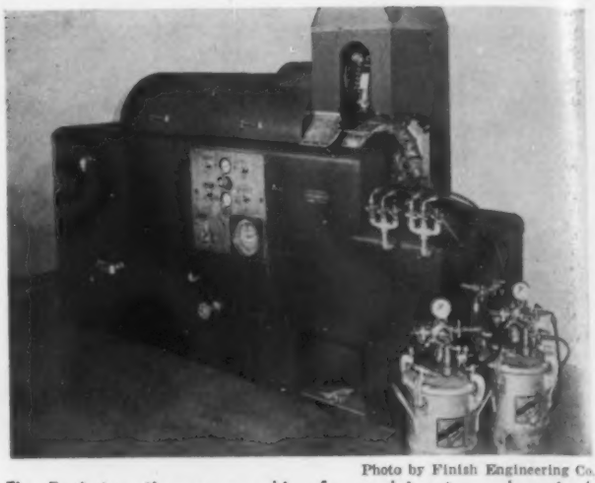


Photo by Finish Engineering Co.

Fig. 7. Automatic spray machine for applying two colors simultaneously is equipped with automatic unloading device and mask washer

cut-out portion of top-most housing. The next mask is filled, and the parts move on to spraying position where the two halves of the plastic part are sprayed with different colors. This is accomplished by using a baffle down the middle of each mask and separating the spray set-ups. As the mask wheel moves forward past the spray position, the plastic part is lifted by a fork arrangement and allowed to slide down to a conveyor.

The wheel is equipped with 18 masks and, as it passes into the main housing of the unit, the masks are washed in acetone so that they are clean for the next cycle. This unit will spray up to 2,000 parts per hour. It has the advantages of fast production and low labor cost, but requires 18 masks and has a rather high acetone consumption.

(To be concluded in November)

Are Tool Plastic Standards Needed?

(Continued from page 555)

tools. Independent thinking and development should not be discouraged. On the contrary, it should be encouraged in every manner possible, but at the same time kept under tight control in order that a record will be maintained that permits the accurate duplication of successful developments in future tooling.

In conjunction with its other duties, quality control should record the results obtained from each and every tool built. Tool standards are the basis of the laws which quality control is called upon to enforce. Therefore, unless adequate tool standards are available, it will be necessary to provide unusually complete tool designs and individual specification data sheets with each project.

Conclusions

The establishment of standard tool plastic procedures is an individual project, since every manufacturing organization has certain specialized problems created by its products. In order to establish successful standards, due consideration must be given to:

(1) The type of facilities available.
(2) The quality and training of the existing personnel.
(3) The extent to which line supervision will be expected to control the details of the operation.
(4) The type of quality control and inspection available.
(5) Those peculiar problems which are inherent in the character of the products being produced.

Undoubtedly, there will be other items of major importance which must be considered in every individual case. The tool engineer assigned to the project should study all available information that may be secured from materials manufacturers, trade publications, engineering societies, and the experience of his associates. By combining the information acquired from these and other sources, he will be able to develop the overall picture, analyze it in the light of the individual problems involved, and develop a workable set of tool plastic standards.

A good tool standard is a living thing. It grows continually and is changed as new ideas are developed, new materials are projected, and better ways of doing a given job are made available. Good standards relieve line supervision of the responsibility of providing detailed answers to routine problems. They assure the manufacturer that his tooling will be built under controlled conditions. A tooling program operated in this manner permits plant management to develop realistic schedules and take full advantage of the cost reductions made possible by plastic tooling.

—THE END

Fully Automatic Molding

(Continued from page 550)

molds every time production of that particular part is required.

Limitations

There are fewer limitations with regard to automatic injection molding than with automatic compression molding. Side draws are entirely possible in automatic injection molding since there is no removal of flash to be considered. Long ratios of pin length to diameter can be used, but automatic insert loading is again a limitation. This limitation is true for the same basic reasons outlined under compression molding.

Decorative parts, which cannot be dropped down a chute even though it is padded, cannot be molded automatically. Small parts that have no points for knock-out pins cannot be run truly automatically since they cannot be degated. Family molds do not normally lend themselves to automatic molding complete with degating, since a separation problem is incurred. Obviously, two or three parts of different varieties can be separated, but to separate every part in a complicated toy, for instance, is not feasible. Furthermore, many of the toy parts made in family molds should be left on the sprues and runners so that they can be racked more easily for vacuum metallizing.

New Developments

In addition to the positive comb and ejection system already outlined, new developments in automatic injection molding include hot runner molding and the availability of hydraulic knock-outs on both sides of the machine. Hot runner molding has been publicized and the basic systems of hot runner molding are well known. The availability of hydraulic knock-outs on both sides of the injection machine is something that many tool makers have talked about for quite some time but, insofar as we know, has never been applied to a commercial injection machine. This system facilitates the running of three-plate molds in many cases.

Conclusions

We can now say that automatic molding is definitely here to stay. Its advantages are only partially realized at the present time, but through the ingenuity of molders, tool builders, and machine manufacturers its use will be expanded widely within the next few years.

I firmly believe that the plastics industry, as well as many other industries, will continue to march towards automation. In many cases, the materials with which plasitcs compete are well along on this road. If we are to expand our industry, we must not only catch up but actually surpass these other industries in our ability to shape plastic parts on an automatic basis.

—THE END

Mold Making by Electroforming

(Continued from page (544)

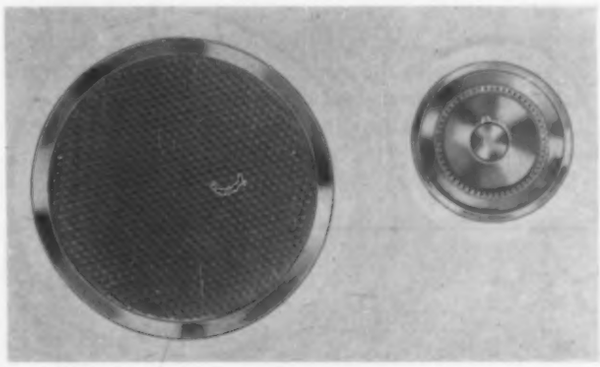


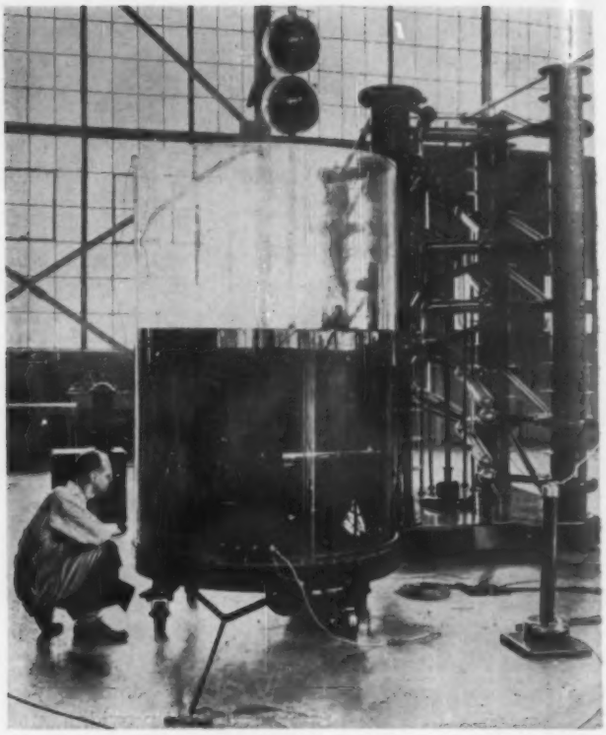
Fig. 6. Electroformed cavities show intricate detail possible with the process. Faceted disc (left) was reproduced from a plastic master.

pared to the cost of a hand-engraved hob, electroforming may provide substantial savings in cost and delivery time.

The electroforming process offers one more tool by which the plastics industry may reach fields into which it has previously hesitated to go. As is the case with all processes, it gives impressive results when used properly. As more and more plastics personnel are educated in the advantages and limitations of the process, it will take its place with other methods as an accepted tool of the plastics industry.

—THE END

Acrylic Tank Aids High-Voltage Testing



Acrylic tank holds oil-immersed transformers during testing

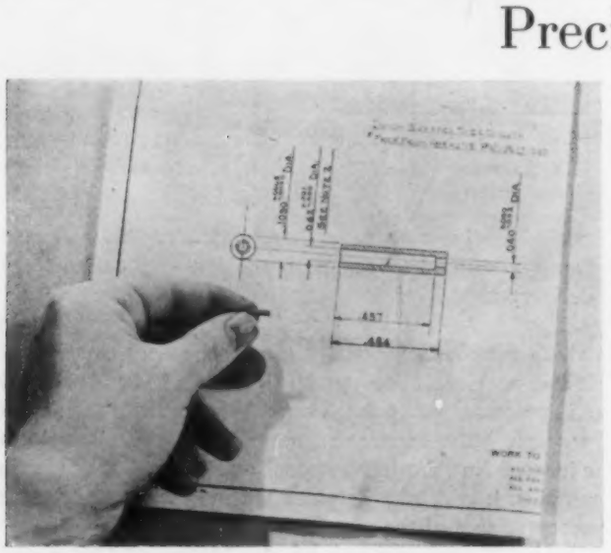
What may be the largest vessel ever constructed of Plexiglas acrylic plastic is being used by electrical engineers in the St. Catharines, Ont., Canada, plant of Packard Electric Co., Ltd., to hold the transformer oil into which prototype transformer coils are submerged for breakdown tests. A conventional steel vessel had been used previously for this purpose, and the limited visibility of this arrangement made it difficult to detect when, where, and how breakdowns were occurring. Thus, the testers frequently were unable to determine the exact voltage that caused breakdown.

After investigating the dielectric and oil-resistance properties of acrylic plastic, Packard engineers had Crystal Glass & Plastic, Ltd., Toronto, fabricate the new tank from clear, ½-inch thick Plexiglas sheet made by Rohm & Haas Co., Philadelphia, Pa. Two large sheets were heat-formed into a cylinder measuring five feet in diameter and eight feet in height. The bottom and side seams were butted and supported by acrylic reinforcing strips, then solvent-cemented to form tight joints. A circular steel base for the tank, mounted on casters and fitted with a handle, was fabricated at the Packard plant.

In use, 800 gallons of transformer oil are pumped into the plastic tank, filling it slightly more than half-full, and electrical leads are introduced through the open top. Typical test currents imposed are 300 kv. at 60 cycles for one minute, and impulse voltages as high as 750 kv.

—THE END

Precision Molded Alkyd Parts



Plaskon alkyd spring holder

The molded alkyd spring holder, shown in the accompanying photograph, illustrates the mass production of high precision plastic parts that require no machining being performed by Mason, Shaver & Rhoades, East McKeesport, Pa. Used by the government in a precision instrument, the spring holder is molded to close tolerances. It is 0.484 inch long, and has an outside diameter of 0.1090 inch with a positive tolerance of 0.0005 inch. The inside diameter is 0.062 inch with a positive tolerance of 0.0005 inch. For 0.047 inch at one end of the spring holder, the inside diameter is 0.040 inch with a minus tolerance of 0.002 inch. Concentricity of the outside diameter and the larger inside diameter is held within 0.0005 inch. The material used is Plaskon alkyd, made by the Barrett Division, Allied Chemical & Dye Corp., New York, N. Y.

—THE END

News of the Societies

ASTM Reinforced Plastics Group

ASTM Subcommittee XVIII on Reinforced Plastics, which is part of the Society's Committee D-20 on Plastics, held its fourth meeting on July 1 at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J. Subcommittee chairman R. B. Crepps, Owens-Corning Fiberglas Corp., presided over the meeting and commented on the great interest being displayed in reinforced plastics. Reports were heard of the meetings of the Subcommittee's five working sections which preceded this session, as follows:

Section A—Flat Sheets. The proposed specification for glass-reinforced translucent laminates is being held up pending a suitable light transmission test and a specification for glass mat, especially with regard to weight variation. Many changes have been suggested in the proposed specification for glass fabric-reinforced epoxy resin laminates, and the revised specification will be sent to section members for approval balloting.

Section B—Rods and Tubes. Existing ASTM specifications, are being examined to determine their applicability to reinforced rods and tubes. These specifications include D348-52 on Laminated Tubes Used for Electrical Insulations; D349-52 on Laminated Round Rods Used for Electrical Insulation; D618-54T on Conditioning Plastics and Insulating Materials for Testing; D741-52 on Dimensions of Rigid Rods Used for Electrical Insulation; and D668-52 on Methods of Measuring Dimensions of Rigid Tubes Used in Electrical Insulations.

Section C—Corrugated Sheets. A task group has been set up to investigate possible flammability test methods for corrugated sheets. The various SPI test methods which have been compiled for submission to the Department of Commerce as a voluntary industry standard were discussed and it was suggested that the sampling technique be spelled out in these methods.

Section D—Laminating Resins. A new draft of tentative methods of testing polyester resins will be presented for discussion at the next meeting of the Section. It was agreed that procedures on shelf life, hydroxyl number, and specific gravity of cured resin should be incorporated in the compilation on resin curing characteristics that is being prepared. A compilation of testing procedures for epoxy resins in reinforced plastics will be prepared, and the possibility of writing a specification on polyester resins is being investigated.

Section E—Reinforcements. Work is in progress on preparing a tentative specification for finished woven glass cloth used in laminates, and another for chopped yarns and rovings used as reinforcements. A working group is to be set up to work on test methods and specifications for glass mat reinforcements, possibly replacing the government specification MIL-M-15617A, and including parallel or finishing mats.

It was announced that the next meeting of XVIII will be held in conjunction with the D-20 sessions scheduled for November 14-16 at the Netherlands-Plaza Hotel, Cincinnati, O.

Plastics Study Group To Meet

A Plastics Study Group for interested members of the Building Research Institute has been organized by the planning committee. Under the chairmanship of J. K. Honish of Bakelite Co., the Group will hold its first meeting on November 14 and 15 at the University of Michigan in Ann Arbor.

Subjects to be discussed are housing, building "skins," plastic pipe, and plastic vapor barriers. The program will include an inspection of the school's building research program with special attention focused on the Unistrut project, a study sponsored by the Unistrut Corp., and carried on by the School of Architecture.

Members of the planning committee are: J. K. Honish, Bakelite Co.; W. F. Drees, Formica Co.; A. W. Russell, Russell Reinforced Plastics Corp.; J. Hiltner, Rohm & Haas Co.; G. M. Irvine, Owens-Corning Fiberglas Corp.; H. Jandl, Princeton School of Architecture; R. J. Johnson, National Association of Home Builders; C. T. Larson, Michigan College of Architecture & Design; G. Lutz, Turner Construction Co.; H. E. Muhlenberg, E. I. du Pont de Nemours & Co., Inc.; M. F. Gigliotti, Monsanto Chemical Co.; J. Dec, Johns-Manville Research Center; C. P. Roberts, Vorhees, Walker, Smith & Smith; T. E. Werkema, Dow Chemical Co.; and P. C. Wetterau, Congoleum-Nairn, Inc.

Plastics in Building Symposia

SPE's New York Section and the Section's Reinforced Plastics Group featured separate, but interrelated, discussions of "Plastics in Building" at their respective meetings on September 21 and 28. Approximately 100 members and guests attended the regular dinner meeting at the Gotham Hotel in New York City, and about 65 were present for the reinforced group's program at Tufaro's Restaurant, Corona, L. I., N. Y.

Charles Telchin, Telchin & Campanella, Inc., opened the regular session's talks discussing "An Architect's Viewpoint Towards the Use of Plastics in Building." Plastics are a recent addition to the list of structural materials, but a very important one, and Mr. Telchin feels that they offer the best possible medium for an architect's expression. Modern design coupled with modernization of the tools of construction may boost them to the materials of choice in home of tomorrow.

"Decorative Uses of Plastics in Building," were outlined by William Connolly, Bakelite Co. Using a series of colored slides, he showed what his company had accomplished with respect to vinyl flooring, wall coverings, lighting panels, and decorative laminates.

Monsanto's cooperative research program with M.I.T. was brought out by Ralph Hansen in a talk on "Research on Plastics in Construction." Every conceivable application for plastics in the home has been investigated and at least partly evaluated. One of the biggest difficulties, he feels, is that we are trying to construct the home of today with the tools of 1900.

Reinforced Group

Foster Monaco, Mastercraft Plastics Co., opened the reinforced group's program with a discussion of "Prefabricated Plastic Stone." This material might be described as a take-off on Perma-Stone, using fibrous glass-reinforced polyester laminates. Still in the experimental stage, it makes possible a wide range of color combinations, not obtainable with the older material.

"Translucent Reinforced Plastics for Glazing," were illustrated by Harry Friedman of Russell Reinforced Plastics, with a number of material samples and photographs. Almost any translucency is possible, as well as most colors. A model dwelling constructed almost entirely of reinforced plastic panels was displayed.

Although acrylics are not properly a reinforced material, their non-flammability and high degree of light transmission make them a must in any consideration of plastics as construction materials. This was well brought out in a talk by H. A. Williams on "Thermoplastic Light Transmission Panels."

"Corrugated Panels" was the subject of a talk by A. Marisca, Celanese Corp. of America. The entire process was outlined along with fabricating techniques.

Toledo Section Reports

Approximately 30 members and guests attended the September 14 meeting of SPE's Toledo Section which was held at Morgan's Lookout, Toledo, O. Guest speaker for the evening was George H. Sollenberger, Koppers Co., Inc., who gave a comprehensive description of Super Dylan, Koppers' new high-modulus polyethylene. An abstract of his talk can be found in the report of the Cleveland-Akron Section meeting which appears in this issue.

Atlantic Regional Conference

An Atlantic Regional Conference sponsored by SPE's New York Section will be held at the Hotel Statler in New York City on November 16. The Conference will feature an all-day symposium on "Plastics for Packaging," and will include speakers from all the major material suppliers, plus educational exhibits.

All SPE members, as well as other interested individuals are invited to attend, subject to registration. Fees are nominal, and there will be an organized luncheon and dinner at the hotel. The following speakers have been scheduled: T. H. Berby, Sylvania Division, American Viscose Corp.; E. V. Hellyer, Monsanto Chemical Co.; Mark Stringfellow, Spencer Chemical Co.; W. F. Underwood, Visking Corp.; W. D. Lahey, B. F. Goodrich Chemical Co.; E. A. Edburg, Koppers Co., Inc.; Robert Carter, Celanese Corp. of America; L. B. Steel, E. I. du Pont de Nemours & Co., Inc.; Lloyd Stouffer, "Modern Packaging;" and Egmont Arens, designer.

Bakelite Co., Dow Chemical Co., and Eastman Chemical Products, Inc., are committed to supply speakers, as yet unannounced. Additional details can be secured from the Society's national office, 34 E. Putnam Ave., Greenwich, Conn.

Newark Compares Injection Molding & Vacuum Forming

SPE's Newark Section drew an attendance of 140 members and guests at its September 14 meeting, which was held at the Military Park Hotel in Newark, N. J. The subject for the evening's program was a panel discussion of "Economic and Production Comparisons between Injection Molding and Vacuum Forming," with Milton Sanders of Sun Tube Co., as moderator.

The principal speaker was O. H. Yoxsimer, Westinghouse Electric Corp., who compared these two methods in the fabricating of large area (800-2,000 square inches) refrigerator parts from polystyrene and polystyrene alloys. He pointed out that internal strains can occur in both molded and formed parts, with the likelihood of fewer strains in the latter. Flow lines and orientation occur in both, but are more readily forecast as a pattern in forming. Overheating presents a greater problem in forming, but re-use of material is more safely done in forming than in molding.

On the subject of costs, Mr. Yoxsimer showed estimates for one design of an inner refrigerator door panel by both methods. While the molded parts were four cents cheaper per pound, the formed panels could be made 25% lighter in weight which led to a lower cost per panel.

Adolphe J. DeMatteo, Watson-Stillman Co., stressed the importance of injection molding for pieces of complicated shape. Sanford Zimmerman, Vacuum Forming Corp., spoke of the growing use of formed parts in the automotive industry. Saul Blitz, Tico Plastics, felt that size was the governing factor; small pieces being more economical to mold, and large area parts cheaper to form. Robert Barber, Panelyte division of St. Regis Paper Co., commented that capital outlay for vacuum forming is only 50-60% of that required for injection molding, even including the equipment necessary to extrude sheets.

TAPPI Announces Program

TAPPI, the Technical Association of the Pulp & Paper Industry has announced the official program for its National Plastics Meeting, to be held on November 14 and 15 at the Brooklyn Law School, Brooklyn, N. Y. Over-all theme for the meeting is "Plastics Modified Functional Papers," and the talks are expected to represent the most complete symposium on plastic coatings for the paper industry.

Four sessions are planned, each with a separate theme: "Fibrous Material for Laminates;" "Resins Employed in Laminates;" "The Pulp and Paper Industry Speaks on Its Plastic Requirements;" and "Polyethylene Extrusion Coating." The meeting is open to all, with no registration fee required. Copies of the complete program may be obtained by writing TAPPI, 145 E. 44th St., New York 11, N. Y.

Holds Vacuum Forming Panel

The Southern Section, SPE, held its first meeting of the fall season at Mammy's Shanty, Atlanta, Ga., with 50 members and guests attending. The meeting featured a talk by C. D. Quarles, Jr., U. S. Gypsum Co., on "Tooling for the Plastics Industry"; and a panel on "Materials for Vacuum Forming," consisting of Joseph B. Schmidt, Koppers Co., Inc., Joseph H. Jones, Bakelite Co., and W. H. Kuhlen, Marbon Corp.

Mr. Quarles discussed the rapid increase in the use of casting and laminating resins for production patterns. He attributed this largely to the use of plaster cements as a mold medium, describing how a filmstrip is employed in creating and duplicating patterns in plaster. The advantages and disadvantages of Ultracal, Hydrocal, Hydrostone, and break-away plasters were outlined.

The panel discussed the relative merits of such vacuum-formable materials as vinyls, acetates, high impact styrene, polyethylene, and acrylics. It was pointed out that vacuum forming, which utilized two-million pounds of plastic materials in 1950, is expected to consume 50-million pounds in 1955, and 200-million pounds by 1960.

Section president Leo Diamond of Koppers Co., has transferred to Chicago. Vice president Clarence E. Ballentine, Scripto, Inc., will serve out his term.

Discuss Material Developments

SPE's Eastern New England Section and the Boston-Providence Chapter of SPI held their first joint meeting of the current season on September 22 at the Hotel Beaconsfield, Brookline, Mass. Over 100 members and guests heard talks on the latest developments in thermoplastics by three representatives of major material suppliers.

D. G. Welsh, Hercules Powder Co., addressed the group on "Hercocel W," a new type of cellulose acetate. He showed slides comparing costs, properties, and molding conditions as compared with other cellulosics, pointing out that the material was distinguished by a heat distortion point of 225° F. Hercocel W has a Rockwell "M" hardness of 107, and is not recommended in low-temperature applications.

"Cycolac" was the subject of discussion by Howard H. Irvin, Marbon Chemical division of Borg-Warner Corp. A high-impact copolymer of butadiene, styrene, and acrylonitrile, Cycolac is said to offer excellent weld qualities during molding. Mr. Irvin showed a series of slides comparing the material with PVC, butyrate, styrene, nylon, and a rubber blend.

Harry Voskamp, Barrett Division, Allied Chemical & Dye Corp., spoke on "Nylon 8200," pointing out that oriented nylon films show distinct promise in the vacuum forming and packaging fields due to their increased tensile strength.

Cleveland-Akron Section Meets

Over 100 members and guests attended the September 12 dinner meeting of SPE's Cleveland-Akron Section at the Spanish Tavern, Brecksville, O. George Sollenberger of Koppers Co., Inc., spoke on "Super Dylan," his firm's new high molecular weight, high temperature-resistant polyethylene.

It is generally felt that the new polyethylenes will find entirely new applications rather than replace older plastic materials. Super Dylan shows a Shore D hardness of 65, as opposed to 45 for standard polyethylene. Specific gravity is somewhat higher also. Tensile strengths can be as high as 6,500 psi., and a stiffness modulus of 150,000 psi., has been reported.

Vapor transmission rates are about one-third those of conventional polyethylene, a factor to be noted in the packaging field. Super Dylan withstands continuous temperatures of 250° F. without losing shape; however, parts evidence no strength at that heat.

Koppers has announced two types of Super Dylan; 6200 for injection molding, and 6400 for pipe extrusion. Initial prices have been set at 43¢ per pound in natural color, and full production is expected by spring.

New England Hears Talk

Over 90 members of SPE's Western New England Section were present at the Terrace Dining Room, Bradley Field, Conn., on October 5, to hear a progress report on the new low-pressure polyethylenes. George H. Sollenberger, Koppers Co., Inc., was the principal speaker. An abstract of his talk on Super Dylan appears elsewhere in this issue in the report of the SPE Cleveland-Akron Section.

NEWS of the INDUSTRY

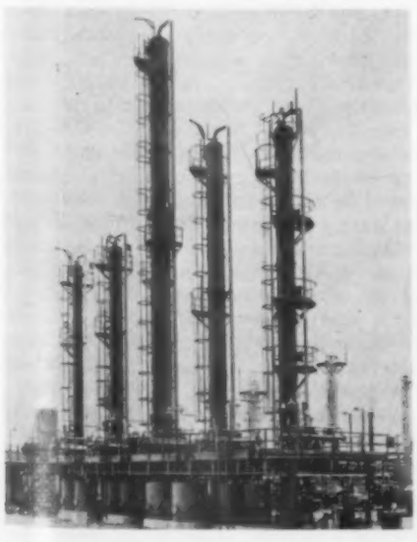
Bulk Containers Cut Costs

Large, collapsible containers of polychloroprene are used for Bakelite Co., New York, N. Y., to ship polyethylene resins in lots of 9,400 pounds net. Reusable, the containers are said to cut resin loss, curb contamination, and reduce handling costs an estimated ½ cent per pound. This saving is then passed on to bulk customers.

The lightweight, synthetic rubber containers have a 300-cubic foot capacity, equal to about 190 of the conventional paper bags they replace. Their 4-ply construction is able to withstand high pressures and resist punctures, sunlight, and grease. Supplied by the United States Rubber Co., they are designed for use in standard bulk transportation units. Special handling equipment and mechanical devices are available for economical and contamination-free cleaning, inspection, filling, loading, and transporting.

Opens Nitroparaffin Plant

Nitroparaffins now are being produced on a large scale for the first time at Commercial Solvents Corp.'s new plant at Sterlington, La. The chemicals are expected to gain widespread usage throughout the textile, protective coating, petroleum, chemical specialty, and photographic industries. Full-scale production of the four basic materials, nitromethane, nitroethane, 1-nitropropane, and 2-nitropropane, is now underway; and conversion facilities are operating at CSC's plants in Terre Haute, Ind., and Peoria, Ill.



Separating columns at new CSC nitroparaffin plant in Sterlington, La.

The completion of the new full-scale facilities represents another step in the firm's long-term petrochemicals development program. The textile industry is expected to consume a substantial portion of the 10-million pound annual output as spinning lubricants and anti-static agents for processing textiles. Surface coatings applications include use as solvents, emulsifying agents, and stabilizers. The petroleum industry will employ the nitroparaffins extensively in crude oil exploration and recovery, and solvent extractions of petroleum products and fuels. Nitroparaffins also are reportedly useful as inexpensive wax emulsifiers and as processing agents for photographic films.

Forms Plastic Model Company

A new firm has been organized to develop plastic products for end-users, stressing the use of precision models. Known as Monmouth Craftsmen, Inc., the new outfit is located at 157 Broad St., Red Bank, N. J.

The use of models makes it possible to examine projected products for possible flaws, merchandising prospects, and production difficulties. Monmouth also supplies material formulations, estimated piece prices, suggested number of pieces, estimated mold prices, and possible modifications.

Monsanto Opens Research Labs

Additional laboratories in a new three-story building are expected to double the research facilities of Monsanto Chemical Co.'s plastics division, Springfield, Mass. Equipment for exploratory, integrated, and end-use research; process and product development; and technical service has been provided.

The additional facilities should enable the plastics division to exploit all phases of research, according to research director Harold W. Mohrman, and will afford greater office and conference space for technical service functions. Emphasis will be placed on application engineering studies, including investigations of structural properties, incendiary characteristics, weather resistance, and end-use temperatures.

Basic research planned for the immediate future will study polymerization mechanisms and polymer structure, and exploratory work on new types of resins. At the other end of the research spectrum, considerable attention will be given to process and product development, and equipment has been provided for experimental work with the six major plastic materials manufactured by Monsanto. New types and larger sizes of fabrication equipment have been installed so that detailed engineering studies can be made on how process conditions affect the properties of plastics.

Monsanto's new plastic research facility. Reception area utilizes plastics extensively.

Plastics and plastic combinations are used throughout the new building for both decorative and functional purposes. The decorative effect in the reception area were designed by Pratt Institute's School of Industrial Design, and contemporary furnishings by Herman Miller make liberal use of melamine wearing surfaces and styrene drawer liners.

Flooring materials include several compositions of vinyl tile, vinyl-bonded cork tile, and resin-bonded wood parquet. Office wall surfaces are painted with a recently introduced water-base paint which has improved water resistance and light stability. Polyester-fiberglass has been used as a light transmitter above metal partitions and in laboratory office walls to provide light, while at the same time maintaining privacy. In addition, there are experimental installations of polyester-fiberglass windows.

Other plastic applications include rigid vinyl luminous ceilings, acrylic chalkboards, vinyl film vapor barrier under the concrete, plastic plumbing, and entry doors glazed with a new form of plastic-laminated plate glass. The latter product has been under development for use in commercial buildings.

Carbide Expands Facilities

Completion of multi-million dollar facilities by Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y., will more than double output of vinyl acetate at the Texas City plant. This unit, a major producer of tonnage petrochemicals, manufactures vinyl acetate by reacting acetic acid with acetylene.

The new facilities are scheduled to commence operation in the Fall of 1956, and will represent a substantial increase in national production. Growing demands for this valuable monomer have necessitated almost continuous expansion.

St. Regis Buys Kline Division

St. Regis Paper Co., New York, N. Y., has acquired the assets and equipment of Kline Mfg. Co.'s plastics division, Galeno, Ill. All vacuum forming and extrusion equipment has been transferred to St. Regis' Panelyte division plant in Richmond, Ind.

Panelyte announced its entry into the vacuum forming field approximately a year ago, choosing Richmond as the geographic center of the refrigeration industry. The additional equipment is expected to enable them to fill existing demands.

Plans Phthalic Anhydride Plant

Construction of a $3-million plant has been undertaken by Pittsburgh Coke & Chemical Co. on Neville Island, just south of Pittsburgh, Pa. Scheduled for completion next fall, the unit is expected to double the firm's production of phthalic anhydride, a basic raw material for the plastics and paint industries.

Increased demand for vinyl and alkyd resins, coupled with increased anhydride consumption by Pittsburgh's own plasticizer division, reportedly are responsible for the firm's decision to expand. The facility will incorporate many improvements in production efficiency and product purity, according to company sources. Lummus Co., New York, N. Y., has been chosen to design and build the new plant.

Westchester Firm Expands

Service to molders in Westchester County, N. Y., should be expedited with the completion of new facilities by Westchester Plastics, Inc., Mamaroneck, N. Y. Demand for masterbatches of thin polyethylene film, polyethylene molding powder, and other custom-compounded thermoplastics was reportedly responsible for the expansion. Work is presently under way to add 3,000 square feet of manufacturing space to the recently completed 6,000-square foot storage area.

Synthane Constructs Again

Synthane Corp., Oaks, Pa., is undertaking its eighteenth major plant expansion since the original factory was built in 1929. The new wing, a 50 by 160-foot structure, will add a total of 8,000 square feet to the existing 167,000.

The new unit will house the automatic screw machine department, and provide increased facilities for lacquering, moistureproofing, and fungicidal treatment of sheet stock, rods, tubes, and fabricated parts. This relocation will make additional space available for the production of copper-clad laminates, the basic material in the manufacture of printed circuits.

Coal Co. Enters Chem Field

Pittsburgh Consolidation Coal Co., Pittsburgh, Pa., has formed a new subsidiary, Pitt-Consol Chemical Co., which will operate a modern cresylic acid refinery at Newark, N. J. The firm recently purchased the Newark plant of Reilly Tar & Chemical Corp., and plans to construct new facilities in addition to renovating existing units. Reilly will consolidate its operations in the Midwest, present center of coal tar processing.

"Research in coal carbonization and the refining of liquids thus obtained has resulted in a process for producing high quality cresylics and related materials," according to Joseph Pursglove, Jr., president of the new firm, "and the new facility will provide an outlet for the most valuable liquid fractions from coal carbonization plants." Other products from this operation will include cresols, phenol, resins, and molding powders. Upon completion in mid-1956, the construction will represent an over-all investment of $3-3½ million.

Uses Tenite Sprinkler System

Over 90,000 feet of Tenite butyrate pipe have been laid as part of the sprinkler system at Porterville State Hospital, Porterville, Calif. Believed to be the largest in the west, the installation precedes landscaping and covers about 50 acres in area.

Butyrate pipe, supplied by Eastman Chemical Products, Inc., Kingsport, Tenn., was chosen for its corrosion resistance, ease of handling, and economy of installation. Butyrate slip-sleeves and solvent cement were used to effect permanent pipe joints with a minimum of time and labor. Pipe sizes ranged from ¾-inch for the smallest feeder lines up to 3 inches for the sprinkler feeds.

Rain-for-Rent, Fresno, Calif., was subcontractor for the installation, and the pipe itself was extruded by Plastipipe, Inc., Los Angeles, Calif. Landscaping was done in accordance with State plans and specifications.

Cement joining of Tenite pipe

New Durez plant in Kenton, O.

Durez Opens Kenton Facility

A $5-million plant employing the latest automation techniques has been opened by Durez Plastics division, Hooker Electrochemical Co., at Kenton, O. The new unit will specialize in long, uninterrupted runs of the largest-volume compounds in Durez's line, enabling the North Tonawanda plant to concentrate on the production of phenol and formaldehyde, the basic raw materials used in the manufacture of Durez phenolic molding compounds.

Two connecting railroads will service the Kenton plant, and trucking lines are readily available for rapid shipment to customers and warehouses. Buildings occupy 15 of the approximately 65 acres, leaving adequate room for additional expansion. The two-plant setup is expected to provide faster and more flexible service to custom molders and manufacturers having their own plastics molding facilities.

Buys Plastic Truck Trailers

Three huge truck trailers made of polyester plastics have been purchased by Reichhold Chemicals, Inc., White Plains, N. Y., one of the largest domestic manufacturers of polyesters. Each of the 32-foot long plastic trailers is 1,200 pounds lighter than an aluminum one of the same size, and 2,000 pounds lighter than a similar stainless steel trailer. The new trailers will be used to transport synthetic resins, industrial chemicals, and dry paint between Detroit and the company's plant at Elizabeth, N. J.

The exteriors of the tandem-axle trailers are of fibrous glass-reinforced plastic fastened by rivet-head aluminum bolts. Interior are guard-sided with polywood coated with laminated resins. Two of the trailers have ¾-inch thick plastic floors. Exterior sheets are impregnated with color that does not require repainting. In addition to being lighter in weight, the bodies provide more space because of the thinness of the plastic sheeting.

The plastic trailers, built by Strick Co., Philadelphia, Pa., give Reichhold a total of 45 trucks in all, including tankers. Strick has pioneered in the use of Reichhold polyester in vans, and is now producing a plastic refrigerator trailer that is suitable for all purposes, including food transportation.

Award to Dow Corning for New Silicone Processes

Dow Corning Corp., Midland, Mich., has been named the 1955 winner of the biennial Award for Chemical Engineering Achievement, sponsored by the technical magazine Chemical Engineering. The company was cited for its process improvements in the field of silicones.

According to Dow Corning, the improvements included the following: a safe commercial process for using the hazardous Grignard reaction to convert silicon-tetrachloride to organo-silicon products; improvements in the direct metallic silicon conversion process that increased production 50%; more efficient polymer finishing processes that provide higher quality and richer yields; and new techniques in hydrolysis.

The company was selected to receive the award by an 84-member committee consisting of senior chemical engineering educators who head departments at colleges and universities accredited by the American Institute of Chemical Engineers and the Engineer's Council for Professional Development. The committee is headed by Walter G. Whitman, director of the chemical engineering department of the Massachusetts Institute of Technology.

Twelve companies or industrial groups have previously received the award. Selection of Dow Corning marks the first time a company has been honored primarily for the successful participation of its chemical engineers in the commercial development of new products, markets, and sales, Dow Corning declares.

Formal presentation of the award will be made December 7 at a dinner in the Bellevue-Stratford Hotel, Philadelphia, Pa., in connection with the 25th biennial Exposition of the Chemical Industries. W. R. Collings, Dow Corning president, will accept the award.

Form Plastics Processing Corp.

A new firm, organized for the buying, selling, and processing of all types of thermoplastic materials, has been incorporated under the name of Amco Plastic Materials, Inc. Located at 80-96 Fourth St., Brooklyn, N. Y., the company was founded by Arthur L. Metzger and Matthew T. Staszak, former vice presidents of the A. Bamberger and American Molding Powder Corporations.

A modern plant and up-to-date equipment are available to custom grind, pelletize, compound, color, and decontaminate primary and secondary thermoplastics. Technical assistance is offered for solving injection molding and extrusion problems, and Amco will purchase scrap, purgings, surplus inventories, obsolete molded parts, and film and sheet trimmings. A low-cost vinyl dry blend and the Amco Purger are being marketed commercially.

Alsynite Expands Facilities

Construction has officially begun on Alsynite Co. of America's new $40,000 administration building in San Diego, Calif. By centralizing all administrative personnel, the firm frees former office space for additional production facilities.

Pioneers in the production of translucent glass fiber-reinforced polyester panels for industrial glazing and decorative effects, Alsynite plans to make liberal use of its product throughout the building. In addition to its headquarters in San Diego, the company has manufacturing plants in Portsmouth, O., and Paterson, N. J.

Polyethylene Film Use to Rise

Polyethylene film may become the universal store wrapping, according to James F. Bernard, sales manager, of the plastics division, The Visking Corp., Terre Haute, Ind. Speaking at a meeting of the national Paper Trades Association in Chicago on September 20, Bernard stated that the unique properties of the material have made it the ideal transparent packaging film for hundreds of products. As new packaging machinery is perfected, additional applications will become available.

Although polyethylene is used successfully for many applications, the speaker warned that the material should be of good quality for maximum success. "In the past couple of years, there has been much polyethylene film converted which is not worthy of the name," he said. It was pointed out that good raw material can be ruined for poor film manufacturing techniques, and it is up to the end-user to stress quality film when ordering the material so as to derive the utmost from use of the film.

Transfer Plastic Molding Work

United States Rubber Co. has completed transfer of its plastics molding equipment from its Chicago Die Mold plant to the Fort Wayne, Ind., plant where more adequate facilities to accommodate its rapidly growing molded plastics business are being made available. Operations at Chicago have been discontinued. Larger molding presses will be added to the present facilities at Fort Wayne for making product by the injection, transfer, compression, and plunger methods.

Chicago Die Mold was purchased by U. S. Rubber in 1951. The continued growth in demand for plastic pipe necessitated the transfer of this operation from Chicago to the modern Fort Wayne plant in 1954. In addition to pipe and fittings, other plastic products of the firm include parts for electrical appliances, industrial parts, household devices, photographic equipment, military parts, and packagings for food, pharmaceuticals, and cosmetics.

Predicts Petrochemical Trend

"Over $30-million is being spent by Esso Research and Engineering Co., New York, on petrochemicals research," according to Esso's Carl O. Tongberg in a speech before the Savings Association League of New York State on September 19.

"Plastics from petrochemicals will play an important part in the actual construction of homes," the company vice president added, "and plastics themselves will account for about half of the total U. S. petrochemical production within the next two decades. The oil industry is spending more than $150-million on research this year alone, and the chemical industries will probably match this figure."

Synthetic Products Expands

A 30,000-square foot addition to the present plant is expected to increase the manufacturing and warehouse area available to Synthetic Products Co., Cleveland, O. The firm hopes to develop new and improved heat and light stabilizers for vinyl plastics, and to expand its list of stearates and specialties. The Synpro technical service department has been enlarged in anticipation of increased demand for the heat and light stabilizers.

Builds West Coast Facility

Styrofoam will be made more readily available to the growing West Coast markets with the completion of Dow Chemical Co.'s new production facilities at Torrance, Calif. Scheduled for opening around the first of the year, it will supplement plants now producing this material at Midland, Mich., and Allyn's Point, Conn.

The plant itself will feature open-air type construction, and will manufacture Styrofoam 22 in white, red, and two shades of green. Self-extinguishing Styrofoam 33 also will be produced.

Hull-Standard Incorporates

Hull-Standard Corp., Abington, Pa., has purchased the Standard molding press business from Standard Machinery Co., Mystic, Conn. The latter company will shift its field of specialization to the extruder and wire coating machinery field.

Hull-Standard was organized specifically to handle all manufacture, sales, engineering development, and customer service on the Standard line of compression and transfer molding presses. Concentration under one management is expected to produce an over-all improvement in service to the plastics industry. The firm has already made several major changes in speed of operation, cycle control, and greater automaticity. Three new lines of presses will be announced within the next few months.

Phillips to Build Marlex Plant

Phillips Chemical Co., wholly-owned subsidiary of Phillips Petroleum Co., Bartlesville, Okla., has contracted for the major portion of construction work on its projected Marlex polyethylene plant at the company's Adams Terminal chemical manufacturing site in Texas on the Houston Ship Channel. Construction is starting immediately on the plant which will have an annual capacity of 110 million pounds.

At the same time, the company announced that construction will start soon on a sales service laboratory at Bartlesville that will initially emphasize Marlex. This laboratory is to be built concurrently with a new chemical research laboratories building at the Phillips Research Center near Bartlesville.

The company had contracted previously for construction of a plant to manufacture ethylene, the basic petroleum material for Marlex, at an annual rate of 120 million pounds per year. This plant is adjacent to the firm's refinery at Sweeny, Tex., and will transport its ethylene to the new Marlex plant by means of a 75-mile connecting pipeline.

Panelyte Forms Sales Section

Consolidation of industrial, refrigeration, and molded plastics sales into a single sales unit has been announced by the Panelyte Division, St. Regis Paper Co., New York, N. Y. Vincent L. Kiernan has been named sales manager for the unit, which will be known as the industrial plastics division.

Panelyte's products include a wide range of laminated, injection molded, compression molded, and vacuum formed plastic items. Applications for these products are found in the electrical, automotive, refrigeration, aircraft, radio and television, electronic, and home appliance industries.

Epoxy Tooling Cuts Costs

Epoxy tools are being used to build interchangeable parts for the U. S. Air Force's new turbojet fighter, the F101A Voodoo, at a reported saving of about 40% in tool cost, 40% in make-up time, and about 75% in weight as compared to metal tooling. Bakelite epoxy tooling compounds developed by Ren Plastics, Inc., Lansing, Mich., are employed in a large number of tools, jigs, and fixtures to maintain close tolerances and assure a perfect fit.

Aluminum door panels for the fuselage skin are assembled on production lines with lightweight fixtures made from a laminate of fibrous glass-reinforced epoxy resin, as is the large inspection fixture for the fuselage. Tools are quickly duplicated and reduplicated from master control models surfaced with Ren epoxy tooling compound.

George G. Stier, new assistant vp of Nopco's plastics division

Nopco Presents Expansion Plans

"The market for polyurethane foams should rise shortly from a few hundred thousand pounds per year to over 100,000,000 pounds yearly," according to Ralph Wechsler, president of Nopco Chemical Co., Harrison, N. J., at a recent press conference held at the Overseas Press Club in New York City. Revealing further details of Nopoc's expansion program into the cellular plastics field, Mr. Wechsler announced the appointment of George G. Stier as assistant vice president in charge of the plastics division, which will open two new plants this year and a third in 1956.

Correspondents at the press luncheon witnessed demonstrations of the various properties of flexible urethane foams. Buoyancy was shown to be 1/20 that of water, and their "no fight-back" quality was evidenced by dropping heavy steel balls on a foam pad. The material's capacity for foaming in place was demonstrated, and finished products were placed on display.

Foamed vinyl was said to be a suitable companion for the polyurethanes, since sponge and foam rubber's shortcomings reportedly are not encountered in this product. A market potential of 170-million pounds has been estimated by 1960. Offering a high density product at low cost, the urethane foams are non-flammable.

UC Forms New Departments

Consolidation of public relations activities and the formation of advertising departments for four of its division companies has been announced by Union Carbide & Carbon Corp., New York, N. Y. These new groups will take over the advertising work formerly handled by the general publicity department.

H. F. Bulkley has been named to head the new public relations department, which will be responsible for the Corporation's public and stockholder relations programs. Appointed to direct the advertising departments of the division companies are: R. W. Boggs, Linde Air Products Co.; G. B. Moynahan, Carbide & Carbon Chemicals Co.; L. F. Granger, Electro Metallurgical Co.; and J. P. Reap, Haynes Stellite Co. There will be no changes in the advertising departments of Union Carbide's other major divisions and subsidiary companies.

In Brief . . .

Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y., has announced a 37% price reduction for alpha-methylbenzyl dimethylamine. New prices are $1.89 per pound for car and truckload lots, $2.00 per pound for five-gallon containers, and $2.15 per pound for one-gallon lots. The material is used as a hardner and curing agent for epoxy resins, and as a catalyst in phenolic-epoxy systems.

Monsanto Chemical Co.'s organic chemical division, St. Louis, Mo., has announced a price reduction of three cents per pound on HB-40, an extender-type plasticizer used in PVC, plastisol, and filled vinyl extrusions.

Seiberling Rubber Co.'s plastics division, Newcomerstown, O., has appointed Paine & Williams, 4616 Prospect Ave., Cleveland, O., and H. B. Strauss Co., 131 Water St., New York, N. Y., as sales agents for its Seilon rigid PVC.

Textileather, a division of General Tire & Rubber Co., Toledo, O., displayed eleven new patterns of vinyl coated upholstery material at the National Furniture Manufacturers Supply Fair in Chicago, August 28-September 1.

Visking Corp.'s plastics division, Terre Haute, Ind., has announced a price reduction up to four cents per pound on its 0.006-inch Visqueen polyethylene film, dependent on the tubing width. This move represents the tenth voluntary price cut due to expanded production facilities.

The Plastics Institute, London, England, has announced a change of address from Adelphi, Adams St., to 6 Mandeville Place, London W.1.

United States Rubber Co., New York, N. Y., is offering two new patterns and a new finish in its Elastic Naugahyde upholstery line, and a new pattern in its Breathable Naugahyde. The two new patterns of Elastic Naugahyde are Polynesian, in 10 colors, and Pebble, in six colors. The new finish is Glazed Antique, in 20 colors and two weights, 27 and 40 ounces. The new Breathable Naugahyde pattern is Pylon, in 12 colors.

Baldwin - Lima - Hamilton Corp. has opened a district sales office for hydraulic presses and testing equipment at 60 E. 42nd St., New York 17, N. Y.

(Continued on page 588)

News from Abroad

Milan Fair Shows Plastics

Plastics in their numerous applications were rather well represented at the 33rd Milan Fair in Italy, held April 12-27. There were colorful displays in the sections devoted to the uses of plastics in buildings and interiors, among others, that attracted much attention. A feature of the plastics section was the wide use of corrugated, often colored, reinforced-polyester resin in the construction of many of the exhibit booth ceilings, walls, and backgrounds. In addition, manufacturers specializing in the material exhibited new applications and effects. One firm not only made panels with the usual wide corrugations, but also some with very narrow flutings in which the surfaces were decorated attractively with variegated designs, while another used plain corrugated panels mounted in metal frames in the construction of a movable shower cabinet provided with a PVC curtain.

Rigid and semi-rigid colored PVC material formed partitions, doors, and roll-up shutters. Doors made of a wood-chip composition with a urea resin binder were also seen. A new type of tile consisted of a cement base to which was firmly bonded a surface layer of colored polyester resin. For hangings and the like, there were PVC-coated fabrics in strikingly handsome designs. The possibilities of melamine resin laminates in interior decoration were explored by at least two Italian firms. One showed artistically-designed panels achieved by the use of special paper on which the pictures were painted in tempera, or by the use of special printed fabrics. Another obtained interesting pictorial effects by interlayers painted with special synthetic resin-based colors. At the exhibit of a manufacturer of acrylics, abstractions painted with colored Perspex by an Italian artist caught the eye.

The footwear section also had some attractive novelties. One manufacturer had an original idea for women's colored PVC sandals; he devised a package containing one pair of PVC soles, one pair of PVC thongs, and instructions showing how the customer, with the aid of a few small accessories in a little bag, could design 12 different sandal styles with the single pair of soles and thongs. Well-designed women's pumps of PVC leather that was not easy to distinguish from real leather, and pink polyethylene bathroom slippers were other attractions in this section.

As to the more technical side of the Fair, no very new developments were noted in plastics materials, but it was quite evident that Italy is producing an increasing variety of plastics. At the Montecatini exhibit were seen its Terital fiber (Terylene), now also made in Italy; its improved polyethylene, known as Rotene, which has a higher molecular weight than the type known as Fertene and withstands temperatures up to 100° C.; and its Algoflon polytetrafluorine. This concern and two other Italian firms (S.I.R. and Leri) have also begun to manufacture melamine resins. Montecatini and Solvic of Milan are perfecting a PVC that can be injection molded. Crespi, of Legano, showed its new product, the first polyurethane foam produced on an industrial scale in Italy. Articles made from Italian PVC and urea resin foams were on view at other exhibits.

The machinery section also testified to the activity of Italian designers and builders of machinery for the plastics industry. Vacuum-forming has made considerable progress here, and several Italian machines were shown at the Fair. There have also been further advances in injection molding equipment and, on a lesser scale, in hydraulic presses. Newer designs in both types are built for higher efficiency and output, and some of the injection molding machines are fully automatic.

A novelty was the automatic multiple rotary press designed by Lombarda Machine, Polvara, Milan, for molding thermoplastic resins. This machine has 12 completely independent molding positions arranged around a central mechanism, and run by a single motor. Each position has its own tank, mold, feeding device, movable hopper, and thermostat for control of temperature, so that it is possible to mold 12 different objects from different urea or phenolic materials in different colors at the same time.

British Census of Plastics Goods

The Report on the Census of Production for 1951, Vol. 11, Trade I, issued by the British Board of Trade, covers certain lines of plastics goods. Largely excluded from this report are complete accessories and fittings made wholly or partly of plastics for the motor vehicle and cycle, mechanical and electrical engineering, radio and telecommunication, scientific, surgical and photographic instruments, and watch and clock trades. These, it appears, are to be dealt with in a further publication by the board.

The list of manufactures that come under the survey strikingly underlines the varied fields into which plastics have made their way: ladies' handbags, toys, games, telephones, parts for optical and scientific appliances, photographic apparatus, hairpins, curlers, knitting needles, buckles, collar studs, lamp shades, caps and closures for bottles, jars and tubes, display fittings, advertising novelties, tableware, furniture, flooring, insulating materials, battery cases, radio cabinets, bathroom fittings, handles and knobs, buttons (actually almost two billion), and unclassified articles.

The total number of larger establishments (employing more than 10 persons) working wholly or partly with plastics and other materials came to 484, of which 280 specialized in plastics goods. The gross output of these plastics firms was valued at £25,477,000, out of the total for all 484 plants of £34,995,000. They employed 23,586 persons out of the total of 34,208, and net output per person was valued at £511. In addition, there was a large number of small firms employing fewer than 10 persons. About 45% of the producers are located in London and South East England, against only 1.8% in Scotland.

The census figures bring out the relative importance of the different types of goods as regards value of output. While the group total for components and semi-manufactured goods made wholly or partly of plastics for use by the electrical, radio, and musical industries, is the highest, buttons head the list of individual items. Such specific items as handles and knobs (not for umbrellas), hair combs, lampshades and reflectors (not for motor vehicles and cycles), and caps and closures, also were represented by relatively substantial amounts.

Plastics in British Radios

Britain's plastics industry played a greater part than ever before in the recent Radio Show of 1955, held in Earls Court, London. Two exhibits, in particular, owed much of their success to plastics; a laminated plastic cabinet for a radiogram unit, and a portable television set covered with embossed PVC.

Plastics at the Show were seen in knobs and switches, three-dimensional badges and escutcheons, grilles, cabinets, and insulations, and included PVC, polystyrene, polyethylene, phenolics, and ureas. In the field of plastic knobs, the use of calendering after molding to impart an attractive finish is gaining in popularity, and has brought about a complete change in design over the past three years. Displays of plastic escutcheons and badges indicated the great progress made with the low pressure or "crush" molding technique.

Injection molded high-impact polystyrene is making strides in radio grilles, supplementing the widespread use of regular polystyrene. A further development in evidence was the increasing use of woven PVC monofilaments in grilles. Displays of plastic radio cabinets indicated that British design is following the contemporary trend to phenolics and ureas. Plastics were prominent in wire coverings and molded electrical insulations, with almost universal use being made of PVC and polyethylene for this purpose.

Germany Promotes Research

West Germany has launched a novel method of promoting for research by issuing a special run of 20-pfennig stamps (roughly equal to a five-cent stamp). These stamps show the globe above an electronic diagram of an atom, symbolizing the macrocosm and the microcosm, and are captioned "Promotion of Research."

Germany's three largest chemical concerns spent large sums on investigations and development in 1954. Farbwerke Hoechst spent about 60,000,000 D.M., or about 5% of its total for the year, on work mainly on plastics and synthetic fibers. In addition, large sums were invested in expanding and modernizing research laboratories. Research and development work at Badische Anilin & Soda Fabrik in 1954 also cost 5% of the company's gross earnings of 1,050,000,000 DM, and the firm has announced that such expenditures for the coming year will be much higher. Farbenfabriken Bayer, which led with total earnings of 1,210,000,000 DM. in 1954, devoted about 50,000,000 DM. to research.

New Plastic Piping Plants

More and more iron and steel manufacturers in Germany are taking up the production of plastic pipe. Mannesmann, Rheinrohr-Wasag, and Dynamit-Nobel Iron Works, Gelsenkirchen, already have established plastics factories for this purpose. Now, it is learned the Buderusschen Eisenwerke, Wetzlar, and the Halberger Hutte G.m.b.H., Brebach/Saar, have jointly founded Omniplast G.m.b.H., & Co., K.G., in Frankfurt-Hoechst, to produce plastic products, particularly plastic piping. The initial capital of 500,000 DM has been fully paid up.

Detecting Leaks in Sub-Surface Plastic Piping

The D.A.V.E. method is a simple way of detecting leaks in sub-surface piping made entirely of plastics and having internal diameters of 12-53 mm. The method is based on the insulation properties of the material, since a system of plastic piping forms a dielectric network.

The method involves the use of a loose plug which is introduced into the piping and is carried along by the liquid in it. Three types of plugs are used: neutral plugs made of a light elastic dielectric material; active plugs made of compounds capable of creating a detectable electric field; and mixed plugs which include both the foregoing types either in juxtaposition or in succession at definite intervals.

In a very simple application, as in the case of a long, straight system of piping having few branches, the leak is found as follows: The system is disconnected at the point where the liquid is fed in, and a neutral plug is introduced. Before the system is connected again, a volumetric water counter or similar device is cut in, as well as an electrode which is connected to a very low amperage, high-voltage current source and grounded. The appropriate valves are opened and the plug is propelled by the fluid between the starting point and the leak. When it passes the leak, there is an immediate reaction, which sets off some signal (such as a warning sound or a light). The system is shut off at once, and the distance of the plug from the inlet at this instant is indicated by the liters of water measured on the counter. The site of the leak, exact to within a few meters, can be marked off on the plan.

With a complicated piping system, an active plug is used, in the nose of which a suitable radioactive isotope is enclosed. After this plug is introduced, the system is operated with the valves closed. The plug goes to the leak, then the site of the plug is marked at the surface. In addition, both methods can be combined, and emission of current utilized alternately with detection at the surface.

New Spanish Developments

Various Spanish manufacturers of chemicals have recently expanded their programs. Industrias Quimicas de Luchana is to manufacture dioctyl, dimethyl, dibutyl and diethyl phthalates. Union Quimica del Norte de Espana will increase its daily output of phenol from 5-10 tons, and its production of hexamine from 225-900 tons annually. It also expects to begin making pentachlorophenol. Manufacture of benzyl chloride and chlorinated derivatives of toluene is to be undertaken by Industrias Quimicas Reunidas S.A. of the Cros group.

PVC Production in Yugoslavia

The production of PVC in Yugoslavia was decided on in 1948, and a plant, the Jugovinil Works, erected at Kastel Sucurac, near Split. This enterprise has become one of the largest and most important in the country. It has the advantage of being close to the sources of the chief basic materials; it is supplied with calcium carbide from the near-by Dugi-Rat Works, and obtains salt from the sea. The plant is up-to-date, and manufacture has been based on processes developed by European and American manufacturers. Production of PVC began late in 1950 with an annual output of only one ton of powder, but progress has been rapid and output figures for the first five months of 1955 include 1,392 tons of powder and 762 tons of materials.

The PVC is made in paste, granulated, and powder form in four main types: Juvidur, a rigid plastic; Juviflex, an elastic plastic; Juvidurflex, a semi-rigid; and the so-called Vinyl Leather. Juvidur materials include tubing up to 14-15 mm. in diameter, profiled rod, parts for chemical apparatus and machinery for the chemical industry, and panels in various thicknesses for use in containers for the chemical industry.

Tubing for a number of purposes also figures among the Jugoflex materials, besides channeling for doors and windows of automobiles and the like, electrical insulations, and sheets. The sheets come in two widths, and are supplied in different thicknesses and colors. The sheets are intended for bookbindings, novelties, rainwear, work clothes, etc. The Juvidurflex materials comprise cable covers, industrial panels, packaging materials, and decorations. The Vinyl Leather also comes in several colors, and is said to be very wear-resistant and moistureproof.

Yugoslavia has developed a relatively active export business in PVC powders and, since 1953, has also begun to export PVC materials. Available statistics for output and exports during 1951-1953, inclusive, are as follows:

	Production, tons		Export, tons	
	Powder	Materials	Powder	Materials
1951	1,090	480	434	—
1952	1,976	824	591	—
1953	2,400	1,168	2,460	241

The exports go to a number of countries in Europe, America, and the Near East. The best customers in 1953 were Germany, which took the greater part of the PVC powder, and a fair amount of materials, and Brazil, which bought almost half the materials and a substantial quantity of the powders. Other countries to which the products went were Austria, Turkey, Greece, and Finland; a few tons even went to the United Kingdom and the United States.

British Exports

Despite a sudden drop in plastics exports from Britain in June to 4,771 tons, as compared with 7,615 tons in May and 7,322 tons in April, total shipments for the first half of 1955 came to over 40,000 tons, topping the figure for the corresponding 1954 period (in a record year) by about 15%. The June recession, which seems to have been caused by the transport and dock strikes, chiefly affected vinyl resins which showed shipments under 600 tons, as against average monthly shipments in the first five months of 1955 of about 1,250 tons; polystyrene molding powders, where the previous monthly average of 700 tons dropped to less than 450 tons; and other unspecified molding powders for which the drop was to 420 tons from a previous average of 900 tons.

Plastics in Brazil

The industrial city of Sao Paulo and its environs account for about 87% of Brazil's total production of plastic materials, a figure which has grown to 11,475 tons annually. With total consumption at 16,930 tons, the difference of 5,455 tons has to be imported. Little or no finished products are imported, however, since domestic manufacturers have been able to meet current demands.

Plans are underway to raise the annual capacity to 24,750 tons, and thus make Brazil an exporter to surrounding countries. Approximately half of the industry's capital is of Brazilian origin, and represents 38 companies. American capital accounts for an additional 30%, and is invested in 18 firms.

NAMES in the NEWS

Robert L. Spitzer

Robert L. Spitzer has been named general manager of the injection department of Fortune Laboratories, Inc., Des Moines, Iowa. Previously with General Electric Co. where he supervised a 23-machine plastics injection molding shop, **Mr. Spitzer** also has wide experience in heavy machine tool design, and in construction and electromechanical engineering.

Ernest Port has joined the reinforced plastics division of Brunswick-Balke-Collender Co., Marion, Va., as project engineer. He was previously on the staff of Goodyear Aircraft Co.

Victor E. Buehrle, Jr., has been appointed technical sales representative for the General Tire & Rubber Co., Akron, Ohio, on the firm's products for the rubber and reinforced plastics industries.

Martin G. Gale has been appointed director of technical service for the monomer department of The Borden Co.'s chemical division in Leominster, Mass. The department's laboratory assists industrial users of polyvinyl alcohol, PVA, and other Borden resins.

Robert B. Battersby has been appointed manager of the thermosetting division, Auburn Button Works, Inc., Auburn N. Y. He formerly served as chief engineer for the diivision.

Harold Kehoe, sales and service engineer for the plastics division of Fellows Gear Shaper Co., Springfield, Vt., has been transferred from the East and Midwest area to the Los Angeles office. His move represents a part of Fellows' expanding sales program on the West Coast.

Gordon W. Engdahl has been advanced to technical director of the fibrous and industrial tape division, Minnesota Mining & Mfg. Co., St. Paul, Minn.

Thomas J. Desmond has been appointed Chicago district sales manager for Grasselli Chemicals department, E. I. du Pont de Nemours & Co., Inc. Previously Boston district sales manager, he succeeds **W. James Latimore** who moves to Wilmington on special assignment.

Theodore O. Woldt and **Thomas Edward Wilde** have been added to the West Coast technical sales department of Reichhold Chemicals, Inc., White Plains, N. Y. They will serve with the Los Angeles Azusa plant and the South San Francisco plant, respectively.

William M. Larson has been promoted to the rubber and plastics compounding section, research division, The Goodyear Tire & Rubber Co., Akron, O.

Paul M. Bogner

Paul M. Bogner has been assigned to the Chicago district sales office of Emery Industries, Inc., Cincinnati, O. He will handle all Emery chemical products, including fatty acids and derivatives, plasticizers, and textile oils, in Minnesota, Wisconsin, northern Iowa and Illinois, and part of metropolitan Chicago. Holder of a B.S. in chemistry from the University of Southern California. **Mr. Bogner** was associated with Inland Wire Co. and Chas. Pfizer & Co. prior to joining Emery.

Ralph W. Poole, Jr., has been appointed to the newly-created post of assistant manager of advertising and sales promotion for Shawinigan Resins Corp., Springfield, Mass. He has served with Monsanto Chemical Co.'s public relations department in connection with the firm's plastics division. **Charles A. Godsell** and **Bruce E. Porter** have been added to Shawinigan's newly established sales force.

William H. Cox has been appointed plant manager of Shaw Insulator Co., Irvington, N. J.

Bob Jones

David D. Jones

David D. Jones has been elected vice president and director of Extruded Plastics, Inc., Norwalk, Conn., a subsidiary of Vick Chemical Co., New York, N. Y. He had previously been in charge of engineering and production.

George R. Waugh, Jr., has been named general manager of Industrial Vinyls, Inc., manufacturers of custom vinyl extrusions. He will be in charge of the company's newly-opened plant at 5511 N. W. 37th Ave., Miami, Fla. **Mr. Waugh** has also taken charge of sales operations, and is preparing to name New York and Chicago representatives.

Jacques Benvenista, Arnold Gruben, and **Harold Hudson** have been appointed to the resin and polymer section of Resin Research Laboratories, Inc., Newark, N. J. **Leonard Feiler** joins the coating section.

W. J. Reagan has been appointed organization administrator for the chemical division of Koppers Co., Inc., Pittsburgh, Pa. **M. K. Dawson,** former assistant production manager, succeeds him as assistant plant manager at Kobuta. **R. F. Seubert** becomes supervisor of the division's sales office, replacing **J. C. Ferraro** who has been assigned to the Detroit sales office.

Wayne N. Grubaugh has been appointed purchasing agent for the Bolta Products division, General Tire & Rubber Co., with offices in Lawrence, Mass. He replaces **Francis Jones,** who has been assigned to the organization of the division's production scheduling department.

Jack C. H. Stearns has been elected to the newly created office of executive vice president for Dow Chemical International, Ltd., and Dow Chemical Inter-American, Ltd. He has served with Dow since 1937, and was recently elected to the export board of directors.

Harry S. Ferguson, vice president of Allied Chemical & Dye Corp., New York, N. Y., has been elected to the board of directors of the Manufacturing Chemists' Association. He has been active in MCA affairs for a number of years, and recently served as chairman of the public relations advisory committee.

William T. Rossiter, Jr., former manager of leather industry sales for Dow Corning Corp., Midland, Mich., has been appointed manager of leather and textile sales. **Willis D. Dicome** becomes assistant manager of textile sales, **Robert E. Vidal** was named assistant manager of leather sales, and **Charles J. Lenz** has been appointed assistant merchandising manager in the textile and leather divisions. The changes are expected to increase promotion of Dow's silicones to the above-mentioned industries.

John Cameron has been appointed assistant chief engineer for the Hamilton Division, Baldwin-Lima-Hamilton Corp., Hamilton, O. He previously served with Clearing Machine Co.

E. J. Fox has been named assistant works manager of Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. He has held several positions within the firm since 1930, the latest being plant superintendent of the Texas City, Tex., unit.

Noel V. Wood, Jr., has been appointed process engineering supervisor for Mobay Chemical Co., St. Louis, Mo. He previously served with the process engineering section of Monsanto Chemical Co.'s organic chemicals division.

F. William DeBree has been appointed general sales manager for American Plastics Corp., New York, N. Y. He has had considerable experience in the manufacture and sales of raw materials, plus promotional activities in plastics products.

Charles C. Spencer has joined the sales staff of Reichhold Chemicals, Inc., and will work out of the Argo, Ill., plant. He has served for nearly 10 years in the development and sales of adhesives and paper coatings.

John F. Ortner was named assistant sales manager, molding compounds department, Durez Plastics Division of Hooker Electrochemical Co., and will be located at Durez offices in North Tonawanda, N. Y. For the past nine years, he was a sales engineer in Durez' New York City district office.

Ernest E. Haupt has been appointed division manager, sales development-national accounts, for the B. F. Goodrich Industrial Products Division, Akron, O. With Goodrich since 1914, he became manager of the industrial products district in Cincinnati in 1948, sales development manager in New York in 1950, and manager of national accounts in 1953.

Carlton H. Gilbert has been appointed director of advertising for United States Rubber Co., New York, N. Y., succeeding **Thomas H. Young** who retires after 39 years of service. **Mr. Gilbert** has been assistant director since 1953.

William Spangler has been appointed head of a newly-established Kansas City sales office, and **M. H. Eberle** appointed a sales engineer at the Chicago office of Resistoflex Corp., Belleville, N. J. Formerly a sales engineer with Pratt & Whitney Aircraft Division, United Aircraft Corp., **Mr. Spangler** will be responsible for sales of Resistoflex hose and molded, extruded, and laminated products in Kansas and Missouri. **Mr. Eberle,** formerly with Weatherhead Co., will service both distributors and original equipment manufacturers.

E. J. Van Dyck, former sales manager of the Textiglass Division, Cheney Bros., has been appointed sales manager of the aircraft division of U. S. Polymeric Chemicals, Inc., Stamford, Conn. This company is actively engaged in the preimpregnation of fiberglass mats and fabrics with thermosetting resins.

Paul H. Hoffman

Paul H. Hoffman, vice president of Spun Lite Corp., Miami, Fla., will head the firm's research activities and direct the development of new products and manufacturing processes. Mr. Hoffman joined the company in 1951, following 15 years of aircraft development work, and is the inventor of the continuous corrugating equipment used to produce fiberglass-reinforced plastic panels.

R. A. Paulbach has been named to the sales management staff of the western division of Resistoflex Corp., Belleville, N. J. Previously with Aeroquip Corp., **Mr. Paulbach** will make his headquarters at the Resistoflex offices and plant in Burbank, Calif.

Loren A. Patrick has joined the Los Angeles sales staff of F. J. Stokes Machine Co., Philadelphia, Pa. He has been serving as a research and development engineer with North American Aviation, Inc.

G. Gordon Schmuck has been appointed west coast representative of Kaykor Industries Division, Kaye-Tex Mfg. Corp., Yardville, N. J. He will provide engineering assistance in the selection and application of Vyflex polyvinyl chloride materials for corrosion-resistant construction.

Mayer Studios

Douglas L. Cochran

Douglas L. Cochran has been appointed vice president in charge of sales for Resin Industries, Inc., Santa Barbara, Calif., manufacturer of vinyl insulation sleeving and tubing. He previously served as administrative engineer with Douglas Aircraft Co., and was active in domestic sales and sales planning.

Jack A. Fletcher has been named technical service representative for industrial chemicals, specializing in wire and cable insulation, for Spencer Chemical Co., Kansas City, Mo. He joined Spencer in August, after seven years in wire and cable work with National Electric Products Co. as chief chemist. Previously, he was with Continental Steel Co. and Blaw-Knox Corp. as a chemist.

J. M. Cole and **J. H. Mathewson** have been appointed product managers, and **George Trigaux** has been appointed assistant product manager for the fine chemicals division, Carbide & Carbon Chemicals Co., New York, N. Y. **Mr. Mathewson** will be responsible for the market development of Flexol plasticizers and stabilizers for vinyl resins, and the other two men will be concerned with chemical intermediates.

Harold E. Mongovan, Jr., has been appointed sales representative for the organic chemicals division of North American Cyanamid, Ltd., Toronto, Ont., Canada. He will handle sales of the division's dyestuffs department in Ontario and Western Canada.

John W. Apgar, formerly assistant general manager of coatings, becomes manager of the new special products section, Irvington Division, Minnesota Mining & Mfg. Co., Irvington, N. J. The new department will handle development and sales of all non-electrical products to industry, such as silicones, oleoresins, and vinyls.

Francis A. Jones has been named manager of production control for Bolta products division of General Tire & Rubber Co., Lawrence, Mass. **Mr. Jones joined** Bolta in 1938, and has been active in the engineering, planning and scheduling, and injection molding of vinyls and other plastic materials.

Lawrence Birdsong has been appointed manager of the press service department, Baldwin-Lima-Hamilton Corp., Hamilton, O., with responsibility for all mechanical press service and repair parts sales.

Edward A. Coleman has been appointed Eastern district representative for the closure and plastics division, Owens-Illinois Glass Co., Toledo, O., with offices in New York City. He has been closure consultant for the packaging research division since 1946.

Fred Elmer has been appointed manager of the new vinyl film and plastic sheeting department of A. Bamberger Corp., Brooklyn, N. Y. He will direct sales to manufacturers, jobbers, and exporters of film and heavy gage sheeting.

John E. Hull has been elected president of the Manufacturing Chemists' Association, Inc., succeeding **William C. Foster.** Previously a general in the United States Army, **Mr. Hull** will have headquarters at the Association's offices in Washington, D. C.

Homer Fry has been named superintendent of production in the coal chemicals division, Pittsburgh Coke & Chemical Co., Pittsburgh, Pa. He will be responsible for production at the phthalic anhydride, plasticizer, sulfuric acid, phenol, and pyridine plants.

R. C. Oglesby has been appointed Detroit district sales manager for Rohm & Haas, Co., Philadelphia, Pa. He succeeds **W. E. Biggers,** who retires at the end of the year. At that time, **Mr. Biggers** will establish a consultant relationship with the firm.

Paul L. Weller has been appointed assistant to the vice president in charge of sales for Spencer Chemical Co., Kansas City, Mo. He previously served as manager of market research, and as district sales manager for Wyandotte Chemicals Corp.

Richard Fulmer has joined the pioneering section, chemical research department, of General Mills, Inc., Minneapolis, Minn. His work in the section will deal with fatty nitrogen products. **Dr. Fulmer** received his bachelor's degree from DePauw University, and a doctorate in organic chemistry from the University of Illinois.

George C. Voss has been elected vice president of I-Sis Chemicals, Inc., Springdale, Conn. In his new position, he will be in charge of production and development work devoted to the continued expansion of the company's chemicals in the field of industrial finishes. **Mr. Voss** formerly was district sales manager for the petrochemicals department of American Cyanamid Co.

"IDEAS IN THE MAKING WITH CIBA PLASTICS"

Hear this!

An outstanding development of great significance in the use of synthetic resins for tooling is this new drop-hammer die at the Lockheed Aircraft Corporation. The high impact die facing material is EPOCAST*, developed by FURANE Plastics based on CIBA Araldite Epoxy Resins. It is hard enough to form most gages of aluminum and thinner stainless steels. In addition to exceptional mechanical efficiency, the EPOCAST facing material economically eliminates die-grinding and spotting that is needed when conventional tools are used. Worth looking into . . . as are *all* CIBA-base plastics. *Trade Name

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New Materials

High Temperature-Resistant Silicone Molding Materials

Four new silicone molding materials, reportedly showing resistance to temperatures of 660° F., plus improved moldability, have been developed by Bakelite Co. Designated GMGA-5001 Natural, GMGA-5002, GMGA-5003, and GMKA-5004, the materials are said to offer greater latitude in electrical component design through substantial weight savings.

GMGA-5001 Natural is a general-purpose, mineral-filled compound which shows the best room-temperature electrical properties and lowest water absorption characteristics of the four materials. Complying with military specification MIL-M-17953 for MSG-type silicone molding materials, it requires storage at temperatures below 75° F., to prevent changes in plasticity. GMGA-5002 is used for similar applications, but has better high-temperature and storage properties.

GMGA-5003 possesses similar electrical properties, and has good storage stability and superior impact resistance. GMKA-5004 is a MSI-30 type material particularly suitable for compression molding. Like 5003, it is glass-filled and has high impact strength. Bulk factor of this material precludes automatic preforming, but hand preforms have been made successfully.

While primarily developmental materials, sufficient quantities are available to meet anticipated demands. Tentative mechanical and physical properties are listed as follows:

	GMGA-5001 Nat.	*GMGA-5002*	*GMGA-5003*	*GMKA-5004*
Tensile strength, psi.:				
At 23° C.	4,000- 4,300	4,000- 4,300	4,000- 4,300	4,700- 5,000
At 200° C.	1,200- 1,800	1,200- 1,800		1,200- 1,800
Flexural strength, psi.:				
At 23° C.	6,800- 7,500	6,800- 7,500	6,100- 6,400	9,000-11,000
At 200° C.	2,000- 2,500	2,000- 2,500	1,500- 1,800	2,500- 3,500
Modulus of elasticity in flexure, psi.:				
At 23° C.	$10\text{-}13\times10^5$	$10\text{-}13\times10^5$	$9\text{-}11\times10^5$	$17\text{-}19\times10^5$
At 200° C.	$4\text{-}5\times10^5$	$4\text{-}5\times10^5$	$2\text{-}3\times10^5$	$6\text{-}8\times10^5$
Izod impact strength, ft.lbs./in. N.	0.25-0.30	0.25-0.30	0.33-0.38	3-6
Compressive strength, psi.:				
At 23° C.	16,000-20,000	16,000-20,000	12,000-16,000	13,000-15,000
At 200° C.	5,000- 7,000	5,000- 7,000	3,000- 5,000	2,000- 4,000
Molded specific gravity	1.8-2.0	1.8-2.0	1.8-2.0	1.8-2.0
Water absorption, %	0.2-0.3	0.3-0.4	0.4-0.5	0.4-0.5
Arc resistance, sec.:	250-420	300-420	250-350	250-350
Flame resistance, sec.:				
Burning time	0-78	40-50	0-60	25-100
Ignition time	170-300	186-220	190-300	90-125

Readers' Service Item M-1

High Heat-Resistant Styrene Molding Compound

A heat-resistant styrene molding compound which can tolerate temperatures of 198-204° F. without distortion has been introduced by the plastics division of Monsanto Chemical Co. Designated Lustrex Hi-Heat 99, the material reportedly sacrifices none of the excellent electrical, physical, and chemical properties of general-purpose styrene.

Lustrex Hi-Heat 99 can be molded on standard injection machines, remembering that this material has a higher melt viscosity and plasticizing requirement than general-purpose styrene. An increase in cylinder temperature of 20-60° is usually satisfactory. Slightly higher injection pressures may be necessary if cylinder temperatures are not sufficient to obtain proper fill.

Clamp time (cooling) should be lengthened, rather than increasing the injection or ram-forward time, in order to avoid packing which results in highly-strained pieces. In some cases, shorter cycles may be obtained due to the material's fast-setting properties. Mold temperatures generally run in the range of 120-190° F.

Standard extrusion equipment can be used, with cylinder temperatures of 450° F. and die temperatures of 425-450° F. suggested. Cementing, machining, and lacquering procedures according to standard techniques for thermoplastics are satisfactory. Properties of the material, as determined by ASTM methods, are listed as follows:

Tensile strength, psi.	8,500-9,500
Elongation at break, %	1-2
Modulus of elasticity, psi.	$5\text{-}6\times10^5$
Hardness, Rockwell "M"	76-80
Flexural strength, psi.	13,000-15,000
Impact strength, Izod, ft.lbs./in.	0.25-0.45
Heat distortion at 264 psi., °F.	198-204
Light transmission, 50-mil specimen, %	88-90
Color possibilities	Unlimited
Specific gravity	1.04-1.06
Moisture absorption, %	0.05
Burning rate, 50-mil specimen, in./min.	1
Bulk factor (pellets)	1.6-1.9
Mold shrinkage, in./in.	0.002-0.008

Readers' Service Item M-2

Phthalate Ester Plasticizer

A primary plasticizer for vinyl chloride resins, said to incorporate the efficiency of DIOP and DIDP, has been introduced by Barrett Division, Allied Chemical & Dye Corp. Called Elastex 18-P, the material is chemically identified as an iso-octyl isodecyl phthalate.

Vinyl formulations plasticized with Elastex 18-P reportedly are characterized by resistance to heat-aging. Typical properties are listed as follows:

Odor	Faint
Color, Hazen	30
Molecular weight	418.6
Specific gravity @ 20/20	0.976
Pour point, °C	—30
Viscosity, cps.:	
At 5° C	222
At 25° C	60
At 50° C	20
Refractive index, n20/D	1.4858
Flash point, open cup, °F	415
Fire point, open cup, °F	480
Acidity as phthalic acid, wt %	0.005
Saponification number	267.8
Weight, lb./gal., @ 68° F	8.1

Readers' Service Item M-3

Heat-Stable Calendering Resin

A thermoplastic modified high-styrene resin, designated as Plio-Tuf C75, has been introduced by Goodyear Tire & Rubber Co.'s chemical division. Designed primarily as an easy-processing calendering resin, the material is used in the production of rigid sheets having exceptional stiffness and low temperature impact. Unpigmented sheets in thin gages exhibit translucency; colored and heavy-gage sheets are opaque.

Plasticizers are not required; however, loaders and fillers may be added if desired. After mixing, Plio-Tuf C75 is fed to conditioning mills which have been preheated to 300-340° F. Trimmed stock is fed directly back to the mills without regrinding, which results in considerable savings to the processor. Pig- rather than strip-feeding to the calender is recommended.

Calender speeds up to 10 yards per minute are reported. Press lamination and embossing are said to produce a relatively strain-free material with excellent detail and pattern stability. Sheet properties are listed as follows:

Specific gravity	1.01
Tensile strength, psi	2,300
Elongation, %	60
Hardness, Shore D	70
Impact strength Izod, ft. lbs./in.:	
At 0° F	1.6
At 77° F	5
Heat distortion at 66 psi., °F	190
Modulus of elasticity in flexure, psi	148,000
Water absorption, 24 hrs. @ room temp., %	0.865
Volume resistivity at 1 kc.	4.1×10^{12}
Dielectric constant at 1 kc.	1.93
Dielectric strength, volts/mil	442
Power factor at 1 kc.	0.0028
Chemical resistance	Excellent

Readers' Service Item M-4

Isocyanate Resin and Catalyst

Nafil materials, recently introduced by Chase Chemical Corp., consist of an expansible polyisocyanate and its catalyst, both in liquid form. When mixed, the resin reacts with the catalyst to form carbon dioxide gas and a high molecular weight polymer which will foam in place to as much as 30 times its original mass.

Nafil foam reportedly has exceptional adhesion to such construction materials as metal, wood, masonry, concrete, stone, and glass, with bond strengths approaching the tensile strength of the foam itself. No primer is necessary, and the foam forms a tenacious bond even to damp surfaces. Bands, clips, and adhesives are not required to anchor the foam, a factor which eliminates frost and moisture creep.

Nafil may be sprayed or poured to fill any and all odd-shaped voids. It is further stated that Nafil can be foamed in place between thin sheets of plastic, composition board, metal, or plywood to form rigid sandwich panels. The foam is white when first set, but turns yellow upon exposure to light. This does not affect the foam's properties, but makes painting necessary if appearance is a factor.

Very good thermal and acoustical properties are reported; the latter, particularly with low-density foams. Foam densities as low as two pounds per cubic foot can be made; the higher the density, the greater the rigidity and strength. Resistant to petroleum and coal tar solvents, acids, and alkalies, the material presents no fire hazard during application and will not support combustion when set.

Storage at 55° F. is recommended to prevent coarse and irregular foaming. The K-factor for a 2.25-pound density foam is 0.24 at 75° F., and is only 0.29 for a 16-pound density foam. This low thermal conductivity makes the foam an excellent insulation material. Nafil foam is recommended for continuous use at temperatures up to 212° F., depending on the load. Great savings in shipping, storage, and handling costs are obtained, since enough resin and catalyst to fill an average boxcar with 2.5-density foam can be shipped in 14 drums of resin and 56 gallons of catalyst.

Readers' Service Item M-5

VANDERBILT
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VANSTAY C—Provides efficient heat stabilization at low cost in tile formulations.
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This combination provides excellent heat protection for vinyl compositions during processing and in service.
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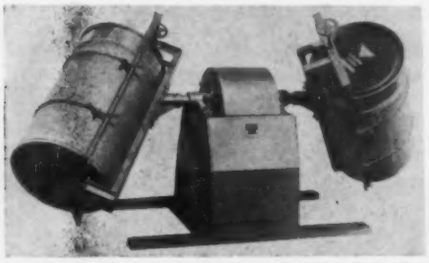
New Equipment



IMS Model T2C extra heavy duty drum tumbler

Heavy Duty Drum Tumblers

Two new model drum tumblers have been added to the IMS line, designed expressly for handling dry color work in injection and extrusion plants. Injection Molders Supply Co., now offers a 2-hp heavy duty model which handles 300 pounds (150 pounds per drum), and a 3-hp extra heavy tumbler with a 300-400 pound capacity.

Designated Model T2B, the 2-hp tumbler takes drums which measure 23¼ inches maximum diameter by 37 inches in height. The machine itself requires a floor space of 84 by 48 inches, and an operating space of 108 by 48 inches to clear the rotating drums.

Model T2C 3-hp tumbler takes drums up to 24 inches in diameter, with a maximum overall height of 45 inches and a minimum drum height of 35½ inches. The floor space required by this model is 86 by 52 inches; operating space is 110 by 52 inches.

Easily clamped-on hoods replace the usual drum lids, and eliminate lost space required to give tumbling room. Among the advantages listed for T2C are labor savings, no spillage, and reduced danger of contamination. Speeds are conventionally 33 rpm., and the double tumbling action is based on a design suggested by Plas-Tex Corp., Los Angeles, Calif., pioneers in dry coloring work.

Readers' Service Item E-1

Satin Finishing Machine

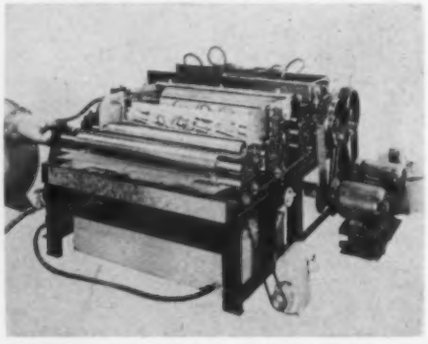
A new machine, designed to impart an over-all satin finish to otherwise high-gloss laminated panels, has been introduced by Fuller Brush Co.'s machine division. Called the Decorative Laminate Satin Finisher, the machine is said to replace costly and easily-marred satin-finish caul plates and press pans.

The unit produces a uniform finish consistently throughout a production run, and salvages possible rejects by blending surface imperfections. It is also possible for the laminator to run off his entire production with high gloss finishes, that can be "dulled down" to fill particular orders.

Completed panels are covered with a pumice and water solution, passed under two rotating tampico-mixture Fullergript brushes for dulling, and finally through a set of Bristand brushes for washing. The finish quality is controlled entirely at the brushing operation, and the machine can be modified to suit any specific requirement.

The Decorative Laminate Satin Finisher is available in two sizes, 50 and 62 inches wide. The smaller model requires a floor space of 10 by 11 feet, and stands five feet high. A minimum laminate length of 36 inches can be processed in standard machines, and panels ranging in thickness from 1/16-¾ inch can be accommodated.

Power requirements include two five-hp dulling brush motors, a one-hp washing brush motor, a ½hp feed roll motor, a ⅓ hp oscillator motor, a ¼hp pumice pump, and a 7½hp blower motor.



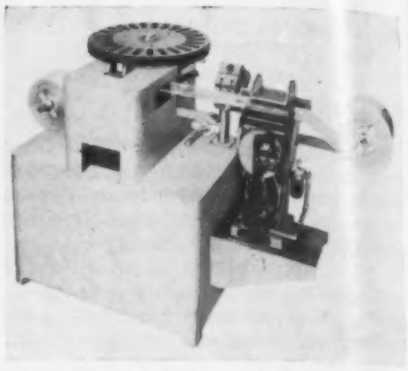
Fuller Brush's plastic panel finisher

Readers' Service Item E-2

Automatic Former-Printer-Sealer

Flexible, two-dimensional packages can be formed around a product, imprinted, filled, and heat-sealed with the new Pak-Rapid machine recently introduced by Pak-Rapid, Inc. Equipped with a Markem Model 70AI printing unit, the machine operates from roll stock at rates up to 3,600 per hour.

Vertical feeding principle permits packaging of single items and assortments in a wide variety of shapes without change



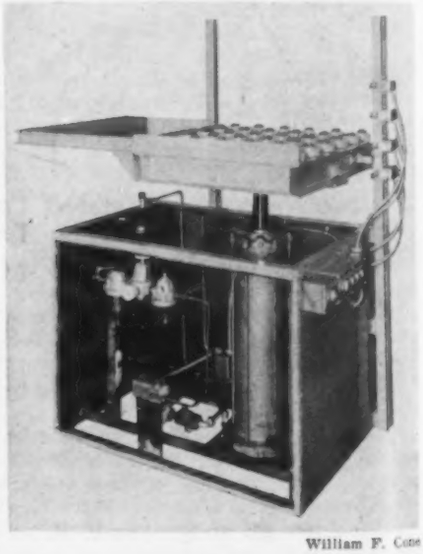
Pak-Rapid's automatic package former, imprinter, and sealer machine

of adjustment or feed. Positive registration is assured by printing head cycling through an acivated microswitch. Other reported advantages include variable speed drive, automatically controlled sealing pressure and temperature, and automatic safety features.

Readers Service Item E-3

Automatic Loading Table

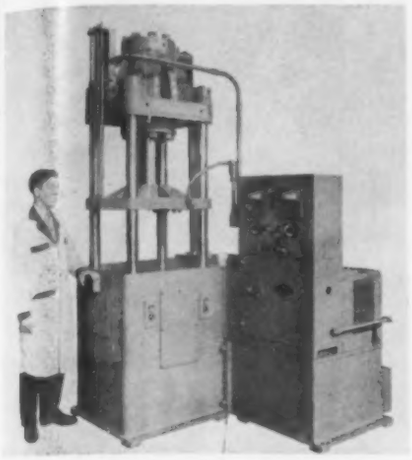
A pushbutton-operated elevating loading table for loading and unloading a multiple opening press has been placed on the market by Loomis Engineering & Mfg. Co., Newark, N.J. Designated Model 130, the air-powered unit has a table which is raised or lowered to any one of two or more pre-selected press opening levels by pushbutton. Plain or ball transfer table tops are available. The unit comes in a variety of sizes and load ratings.



William F. Cone

Loomis press-loading table

Readers' Service Item E-4



Baker 75-ton automatic compression press

Automatic Compression Press

A 75-ton automatic compression press for thermosetting materials has been introduced by Baker Brothers, Inc. Designated Model 400-75, the press features a closure speed of 9.6-366 inches per minute, with automatic deceleration at any desired point in the pressing stroke. Complete flexibility of control over any kind of cycle is reported.

Motor, pump, and valves are easily accessible. The hydraulic system is powered by an Oilgear duplex axial piston pump, and a specially-designed drilled steel block manifold eliminates all flexible lines to minimize leakage. Electrical controls provide for automatic feeding, ejection, flash cleanout, and de-gassing. Potter and Brumfield relays permit instant change without down-time.

A special safety device, a set limit switch, prevents mold damage in case of ejection failure. In semi-automatic operation, the press is operated by dual cycle buttons for operator safety. Standard equipment includes double hydraulic ejectors, which provide for both upper and lower knockouts.

The press is L-shaped, and measures 62 by 68 inches along the outersides. Inner free area measures 30 by 32 inches. Other specifications are listed as follows:

Platen area, in	16 x 20
Stroke, in	12
Daylight opening, in	28
Over-all height, in	96
Weight, lbs	7,000
Hydraulic cylinder, in	8.75
Maximum hydraulic pressure, psi	2,650
Air consumption, cu. ft./stroke	0.7
Cycle time, sec	4-12
Oil reservoir capacity, gal	110

Four- and eight-cavity automatic feeders are available, each individually adjustable. Maximum charges per chamber are 220 and 65 ccs., respectively.

Readers' Service Item E-5

Tool Air Hose Valve Coupling

Valve couplings for tool-operating air hose, that can be adjusted to keep the air trapped in the line when the tool must be changed, has been introduced by C. B. Hunt & Son, Inc., Salem, O. Called Quick-As-Wink Valve Couplings, they have a knurled brass sleeve that may be turned to an "on" or to an "off and exhaust" position, as required. A locking device prevents accidental moving of the sleeve. The couplings are designed for line air pressures up to 250 psi., and are manufactured in ¼-, ⅜-, ½-, and ¾-inch sizes.

Quick-As-Wink Valve Coupling

Readers' Service Item E-6

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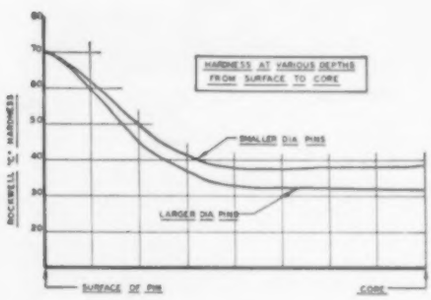

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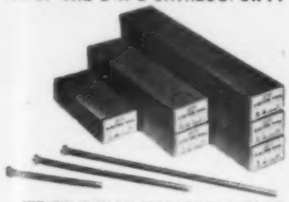

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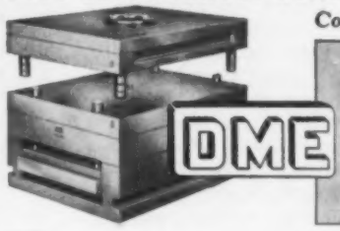

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3355

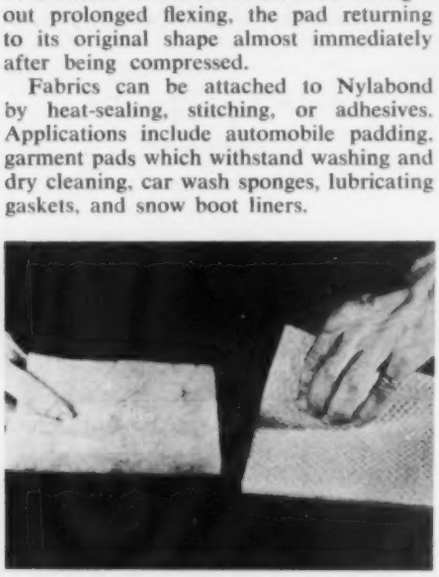
New Products

Nylon-Phenolic Padding

A highly-resilient padding material composed of nylon fibers bound together with Bakelite phenolic resins has been developed by Gustin-Bacon Mfg. Co. Called Nylabond, the lightweight material features high tensile, shear, and impact strengths. Additionally, it withstands dry heat or steam at temperatures up to 350° F. for short periods, and up to 250° F. over extended time intervals.

Nylabond is impervious to cold, mold, fungus, and bacterial growth. It is produced in densities from 1-6 pounds per cubic foot, and in thicknesses ranging from ¼-2 inches. Resilience is retained throughout prolonged flexing, the pad returning to its original shape almost immediately after being compressed.

Fabrics can be attached to Nylabond by heat-sealing, stitching, or adhesives. Applications include automobile padding, garment pads which withstand washing and dry cleaning, car wash sponges, lubricating gaskets, and snow boot liners.



Nylon-phenolic pad shows flexing resilience

Readers' Service Item P-1

Reinforced Plastic Oars

What are reportedly the first all-fibrous glass-reinforced polyester oars have been introduced by Plastic Age Reinforced Products, Inc. Hollow in design, the oars are molded in matched metal dies to prevent warping, splitting, or checking.

Removable handles open the full length to provide a built-in fishing rod compartment. Being hollow, the oars float and require less effort for rowing. An integral oar lock permits vertical, horizontal, and rotational movement without collars or other attachments.

Removable oar handle permits storage of fishing rod

Three models are available in five permanent colors, and in various lengths. The polyester resin chosen for the job was Plaskon, a product of Barrett Division, Allied Chemical & Dye Corp.

Readers' Service Item P-2

Molded Fiber Glass Boat

A new type fibrous glass-reinforced boat, molded in one piece from a seamless preform, has been introduced by the Molded Fiber Glass Boat Division. Trade-named Molded Fiber Glass, the 15-foot seven-inch lapstrake boat is molded in matched metal dies with reinforcing cross-ribs of parallel-strand glass fibers bonded to the hull for extra strength.

Test boats which have undergone hundreds of hours of rough water treatment are said to have proved themselves to be the most rugged boats built, pound for pound. Molded-in hull color is said to require no further painting or maintenance. The plastic material can neither corrode nor rot, nor can it attract barnacles.

The boat has a 68-inch beam and a 30½-inch maximum depth. Gunwales, decks, transom covers, seats, keels, and other reinforcements are of top-grade mahogany.

One-piece molded fiber glass speed boat

Readers' Service Item P-3

Liquid-Measuring Dispenser

A new type of bottle fitment that automatically measures out one teaspoonful at a time, for use when dispensing medicines, shampoos, light syrups, detergents, and other liquids, is available from Isle of View Co. Molded by Calmar Co. of Bakelite vinyl resins, the dispenser, called the Measure Master, is dripless, eliminates extra hand motion, and does away with the need for using measuring spoons. The dispenser shuts off automatically after one teaspoonful is poured each time the bottle is tilted. Pouring three times equals one tablespoonful.

The dispenser is self-cleaning, and needs no attention during the life of the bottle contents. For packaging of liquid products, the dispenser fits bottles having a 28-millimeter threaded neck, and is equipped with an air-tight closure which makes it suitable for in-plant application to containers. The dispenser may be sealed to a container with shrink-on type cellulose bands.

Measure-Master Dispenser

Readers' Service Item P-4

Sunglasses utilize butyrate frames and interchangeable louvres

All-Butyrate Sun Glasses

The latest innovation in costume-matching sunglasses employs interchangeable plastic louvres which snap into the frames to give glareless sun-shading. Called Sun-Slatz, the glasses are molded of light- nonshattering Tenite butyrate by Xobenite, Inc., and are available in a variety of colors.

Slats may be removed in a matter of seconds and a new set inserted to harmonize with a change in dress or sports costume. Sun-Slatz are manufactured by New Products Enterprises, Inc., using butyrate supplied by Eastman Chemical Products, Inc.

Readers' Service Item P-5

"Judge" of Good Pictures

KubeKeeper polystyrene ice bucket

Expandable Styrene Ice Bucket

A plastic ice container, molded from Koppers' Dylite expandable polystyrene, is being marketed by Kent Plastics Corp., under the trade name KubeKeeper. Light yet sturdy, the bucket will not sweat, drip, or otherwise mar furniture, and may be washed with soap and water.

KubeKeeper has a capacity of three quarts, and will keep two trays of ice cubes for as long as 24 hours. Functional and attractive in design, the ice bucket is available in white with a contrasting black lid.

Readers' Service Item P-6

Tinless solder seam withstands 42 pounds internal pressure

Tinless Organic Solder

An organic solder based on a nylon type polymer has been introduced by Dewey & Almy Chemical Co. Still in the laboratory stages, this high strength, side-seam cement is expected to relieve the container industry of its dependence on imported supplies of tin.

The new solder is said to have excellent adhesion to plain metal as well as to most interior lacquer coatings used in cans today. Strength tests show an average of 15 pounds higher than tin-lead solders. The material is applied to can seams at a temperature of 345° F., solidifying when cooled to 275° F. Normal food processing temperatures of 240° F. for 30 minutes do not affect the bond.

Organic solders enable can manufacturers to produce tinless cans, which will be available without the usual "solder stripe." This feature alone may revolutionize can labeling, which can then be an over-all enameling job.

Readers' Service Item P-7

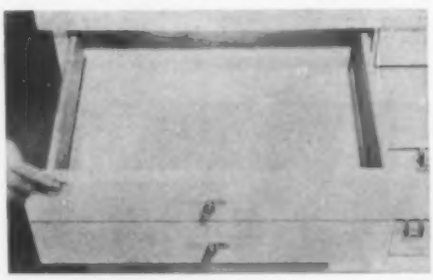
Vinyl cover protects dynel blanket from wet ground

Dynel-Vinyl Blanket

A two-ply blanket consisting of an outer vinyl layer and an underblanket woven from Dynel acrylic fibers has been introduced by Charles Ulmer, Inc. Called Ulmerwarm, the blanket sheds water, and provides a soft and warm under-surface which weighs approximately one-third less than a woolen blanket of comparable size.

The blanket finds application as a waterproof bunk spread for boating enthusiasts or as a picnic blanket. Washable, it requires less than an hour to dry. Standard size is 48 by 80 inches, but custom sizes are available. Dynel fibers are supplied by Carbide & Carbon Chemicals Co.'s textile fibers department.

Readers' Service Item P-8



Plastic-lined dresser drawer

Furniture Drawer Liners

Lightweight, washable plastic liners for furniture drawers are available from Sears, Roebuck & Co. to protect clothes from splinters and make cleaning easier. The liners are extruded and vacuum formed by Panelyte Division, St. Regis Paper Co., from Bakelite high-impact styrene, and look like shallow trays with rounded inside corners. The Harmony House Caravan line of bedroom and dining room furniture by Sears have the durable liners in the

top drawers of the dresser, buffet, vanity desk, china closet, chest, and night table. Each liner is formed to fit snugly, yet be quickly removable and replaceable. The liners can be formed in a wide range of colors to complement the furniture color.

Readers' Service Item P-9

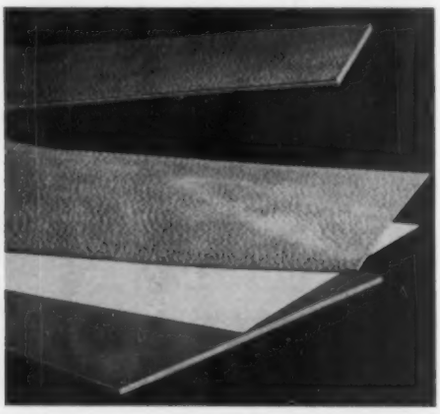
Glass Mat Supported Adhesive

A glass mat-supported adhesive film which bonds metal to metal or to rigid plastics has been announced by Rubber & Asbestos Corp. Designated Plymaster V-2, the film gives evidence of strength up to 40 pounds per inch in peel, and tensile shear strengths of over 2,000 psi.

Originally developed for use as a latent adhesive for bonding metal skins to paper or to metal honeycomb cores in sandwich construction, the formulation was found equally effective in film form. Applications here include a wide range of flat surface bonding combinations, such as metals to metals, reinforced plastic decorative laminates to aluminum, and rigid phenolic or polyester sheets to metals.

Ordinary scissors can be used to cut the film to the desired size and shape. Adhesive pick-up on the reinforcing-base glass mat is approximately five ounces per square yard. Full thickness of the supported film is about 11 mils, although glue lines as thin as 1½ mils can be obtained by applying pressure.

Adhesive flow is obtained in the vicinity of 200° F. Maximum physicals involve a curing cycle of 300° F. for ten minutes at 50 psi.; however, variations in time down to five minutes or less, and pressures as low as 10-12 psi. reportedly can be used. Where desirable, the film may be reactivated by solvent or adhesive primer to yield sturdy bonds at room temperature upon contact pressure. Plymaster V-2 is available in standard 36-inch widths in 100-yard rolls.



Polyester board, aluminum, rigid vinyl, and Plymaster V-2 glass mat-supported adhesive before and after bonding

Readers' Service Item P-10

Caps for Grease Fittings

Plastic caps are being molded by YBF Corp. to help prolong the service life of bearings and bushings by keeping dirt, grit, and water out of high-pressure grease fittings. No bigger than a thumb-tip in size, the tight-fitting caps are molded from Bakelite polyethylene whose toughness and resilience protects the fittings from nicks and burrs. Rigorous testing of the caps by the Navy and Marine Corps in the laboratory and on naval gun mounts, combat vehicles, dump trucks, and amphibian tractors have shown them to be durable and to provide tight seals over a temperature range of —40 to ±200° F. on wet or dry dirt roads, and through water and off-the-road conditions.

Since they are molded in different colors, the caps provide easy identification of grease fittings during lubricating and maintenance. Since greases, lubricating oils, paints, transmission fluids, and water have little effect on the polyethylene caps, they can be re-used indefinitely. The caps also can be used to protect grease fittings during painting, sandblasting, assembly, and storage operations.

Molded polyethylene cap on grease fitting protects bushing

Readers' Service Item P-11

Reinforced Plastic Silo Cap

A fibrous glass-reinforced polyester roof cap for silo domes has been introduced by Hocking Plastics, Inc., under the trade name Silo Lite. Standard equipment for the new concrete farm silos marketed by Marietta Concrete Corp., the dome transforms an otherwise dark silo into a well-lighted storage and work area.

Barrett's Plaskon polyester resin was chosen for the job, because it best met Marietta's standards of translucency and strength. Unaffected by weather, Silo Lite can be used in place of existing dome caps on older silos, as well as on the new models.

Reinforced plastic silo roof cap

Readers' Service Item P-12

Nylon-Vinyl Plastic Covering

Two layers of vinyl film are electronically sealed over nylon fabric to produce a lightweight, low-cost plastic covering which can be used to protect everything from freight cargo to baseball diamonds and ship smoke stacks. Called Herculite, the product meets the most rigid specifications of the Armed Forces for canvas and unsupported plastic coverings.

Among the advantages claimed for Herculite are: long life, waterproof, tear-proof, self-extinguishing, abrasion resistance, and no shrink or stretch. The material needs no drying, yet will not rot or mildew. A product of Fellowcraft Engineering, Inc., Herculite is processed by Radio Receptor Co., using specially designed high-frequency equipment. The material is available in all colors, in widths of 100 feet, and in unlimited lengths.

Herculite tarp used to protect truck cargo

Readers' Service Item P-13

New Literature

"Synvar Resorcinol Resins." Synvar Corp., Wilmington, Del. 15 pages. Descriptions and specifications of the firm's Synvaren PLS resins, including Synvaren PLS-R, a "stopped" resorcinol-formaldehyde resin for RFL treatment of rayon and nylon; and Synvaren 631 and Synvarite BRLD, resin adhesives for fiberglass and rubber.

Readers' Service Item L-1

"Aero Cyanuric Chloride." American Cyanamid Co., industrial chemicals division, New York, N. Y. 46 pages. The properties, chemistry, and applications of this material in such fields as rubber chemicals, plastics and resins, dyestuffs, textiles, and lubricating oils, are described in this booklet.

Readers' Service Item L-2

"Diamond Chlorinated Solvents." Diamond Alkali Co., chlorinated products division, Cleveland, O. 14 pages. Descriptions and physical data on the firm's line of chlorinated solvents, including methyl chloride, methylene chlorided, chloroform, carbon tetrachloride, and perchlorethylene, are presented in this technical bulletin.

Readers' Service Item L-3

"Design File: Rubber-Phenolics." General Electric Co., chemical & metallurgical division, Pittsfield, Mass. 32 pages. Intended for the design engineer, this publication reports the design advantages of GE rubber-phenolics, compares rubber-phenolics with conventional phenolics, and describes 25 case histories of how the use of rubber-phenolics for industrial parts solved perplexing production problems.

Readers' Service Item L-4

"Admex Epoxy Plasticizers for Vinyl Resins." Bulletin No. 101-C. Archer-Daniels-Midland Co., Minneapolis, Minn. 26 pages. The physical properties, compatibilities, and applications of the company's Admex 710, 711, and 744 epoxy plasticizers are reported in this publication.

Readers' Service Item L-5

Publications of Rubber & Asbestos Corp., Bloomfield, N. J.:

"Adhesive Bonding." 6 pages. This reprint of a published article discusses the factors which complicate the specifying of bonding materials and processing techniques and suggests the proper approach to the selection of the correct formulation and process for specific needs.

Readers' Service Item L-6

"Bondmaster Series 'M' Structural Adhesives." 12 pages. This special application report on the company's structural adhesives for porous and non-porous nonmetals, metals, rigid plastics, and rigid plastic laminates discusses specific uses and application techniques and provides a chart for quick reference.

Readers' Service Item L-7

"Heat Stable Phthalocyanine Blue." Bulletin No. 150. Claremont Pigment Dispersion Corp., Brooklyn, N. Y. 1 page. Properties of this blue pigment for vinyl compounding are discussed.

Readers' Service Item L-8

"Fielden Proximity Meter Capacitance Gauge." TM-951-1. Robertshaw-Fulton Controls Co., Fielden Instrument Division, Philadelphia, Pa. 28 pages. The firm's proximity meter for measuring electronically minute variations in capacitance without touching the specimen is described and its applications outlined in this technical booklet.

Readers' Service Item L-9

"Your Handy Checklist of Helpful Diamond Literature." Diamond Alkali Co., Cleveland, O. This is a bibliography of technical and non-technical publications on the company's products.

Readers' Service Item L-10

"Techniques." Barnes Engineering Co., Stamford, Conn. 11 pages. This first issue of a publication devoted to new development in automation equipment, infrared components and systems, and process control instrumentation features a description of Binotrol, the company's punched tape control system that has been applied to the turret lathe and to other types of industrial equipment. Other articles concern radiometers and an automatic assembly machine dubbed Multra.

Readers' Service Item L-11

"Molybdenum Catalysts for Industrial Processes." Climax Molybdenum Co. 24 pages. The commercial and experimental uses of molybdenum catalysts in such chemical reactions as oxidation, hydrogenation, dehydrogenation, isomerization, cyclization, chlorination, and condensation are discussed in this booklet.

Readers' Service Item L-12

"World's Largest Assortment of Rigid Plastic Boxes." Bradley Industries. 20 pages. This illustrated catalog lists approximate inside dimensions and prices for the firm's stock line of rigid plastic containers.

Readers' Service Item L-13

"Automation in the Petroleum and Chemical Industries." Kelloggram, Issue No. 3. 16 pages. Basic functions of instruments used in automatic control, data reductions systems, electronic instrumentation, stream analyzers, and high pressure instruments are described and illustrated in this booklet.

Readers' Service Item L-14

"Castor Oils and Chemical Derivatives." Baker Castor Oil Co. 20 pages. A catalog and product guide to the esters, soaps, fatty acids, and other specialities produced by Baker, it includes temperature-viscosity, plasticizer compatibility, and solubility charts.

Readers' Service Item L-15

"Marvinol VR-30." Bulletin No. 2. Naugatuck Chemical Division, United States Rubber Co. Physical properties, compounding and processing of Naugatuck's PVC resin for film and sheeting are described in this illustrated brochure.

Readers' Service Item L-16

"Wet Blast Cleaning & Finishing News." Wheelabrator Corp. A four-page quarterly publication beginning with the March, 1955, issue. Applications for wet blasting include removing scale, blending directional lines, degreasing, and otherwise finishing plastic parts. Interested parties will be placed on the mailing list.

Readers' Service Item L-17

New Literature (Cont'd)

"Guide to Specialty Steels." Carpenter Steel Co. 32 pages. The distinctive characteristics, in terms of end-use, are given for a number of special steels, such as tool and die steels, stainless steels, silicon and high nickel electrical alloys, valve steels, heat-resisting alloy steels, and tubing and wire specialties.

Readers' Service Item L-18

"Packaging with Plastics." Vol. 1, No. 1. Bakelite Co. 4 pages. The first issue of a new publication on the latest packaging developments and applications, it offers data on the firm's vinyl and polyethylene films for extruders, converters, and coaters.

Readers' Service Item L-19

"Polyfax—Key to Distinctive Styling." Interchemical Corp. 12 pages. This illustrated brochure, in color, explains the Polyfax offset-gravure process for printing wood-grains, fabric designs, leather, and other finishes on metal, wood, composition board, or plastics.

Readers' Service Item L-20

"Fundamentals of Dry Coloring." Plastics Color Co. 4 pages. Materials, dispersants, colorants, blenders, and procedures are explained for applying coloring agents to the outer surfaces of uncolored thermoplastic particles prior to molding and extruding.

Readers' Service Item L-21

"Thermosetting Compositions Based on Polyamide Resin 100 and Epoxy Resin." Technical Bulletin 11-4-3. General Mills, Inc. 8 pages. Properties and advantages of the combination are given as excellent flexibility, good adhesion and gloss, and resistance to solvents and chemicals. Composition and compatibility tables are included.

Readers' Service Item L-22

"Thermosetting Compositions Based on Polyamide Resin 115 and Epoxy Resin." Technical Bulletin 11-6-3. General Mills, Inc. 12 pages. Properties, applications, potting and casting formulation tables, laminates data, adhesive formulations, and coating compositions are given in this brochure.

Readers' Service Item L-23

"4000 Series: Color Paste Concentrates." Technical Bulletin No. 160. Claremont Pigment Dispersion Corp. 3 pages. Properties and prices are given for the 19 polyester-coloring color paste concentrates which make up the "4000" series.

Readers' Service Item L-24

"Emeryfacts: Specifications, and Characteristics." Emery Industries, Inc. 4 pages. Up-to-date specifications on the entire line of stearic acids, oleic acids, hydrogenated fatty acids, glycerides, animal and vegetable fatty acids, plasticizers, and oleic esters are contained in this brochure.

Readers' Service Item L-25

"Nylon Tubing Liner." Technical Bulletin No. 16. The Polymer Corp. of Pennsylvania. 2 pages. The use of Polypenco FM-10001 nylon tubing to guide the welding wire and eliminate galling in a new type of welding equipment is described, along with information on its use in power-driven belts and machined coil forms.

Readers' Service Item L-26

"How the Nosco Plant Works." Nosco Plastics, Inc. 12 pages. This illustrated brochure describes the firm's 227,000-square foot injection molding plant in Erie, Pa. Case histories of routine and difficult molding jobs are included.

Readers' Service Item L-27

"Heat Stable Phthalocyanine Blue." Bulletin No. 150. Claremont Pigment Dispersion Corp. 1 page. Property data sheet on Claremont's new blue-green pigment which is available as a viscous paste for Banbury compounding, as a fluid paste for plastisol use, and as dry granules for extrusion compounds.

Readers' Service Item L-28

"Epocast Tooling Plastics." Furane Plastics, Inc. A compilation of 10 three- by five-inch cards listing the resins, their applications, the appropriate hardeners, and the general formulations used.

Readers' Service Item L-29

"Three Thermosetting Molding Compounds." Barrett Division, Allied Chemical & Dye Corp. 4 pages. Plaskon urea, melamine, and alkyds are described in this four-color illustrated bulletin which emphasizes the end products. A partial listing of properties of these plastics is included.

Readers' Service Item L-30

"Acrylic Esters." Bulletin F-7434. Carbide & Carbon Chemicals Co., division of Union Carbide & Carbon Corp., New York, N. Y. 8 pages. Physical and chemical properties, chemical reactions, methods of polymerization, and applications of the firm's ethyl acrylate, n-butyl acrylate, 2-ethylbutyl acrylate, and 2-ethylhexyl acrylate are discussed in this publication.

Readers' Service Item L-31

Publications of The Goodyear Tire & Rubber Co., chemical division:

"Properties: Plio-Tuf C75 for Calendering." 55-192. 2 pages. The physical, chemical, and electrical properties of Plio-Tuf C75 and its application to the manufacture of thermoplastic calendered sheets for post-forming are reported here.

Readers' Service Item L-32

"Calendering and Laminating Plio-Tuf." 55-193. 4 pages. The techniques of calendering and laminating Plio-Tuf high-impact modified styrene resins are discussed in this publication.

Readers' Service Item L-33

"Compounding Plio-Tuf C75 for Calendering." 55-194. 2 pages. The compounding of this material, including suggestions on the use of colors, fillers, and extenders, is outlined here.

Readers' Service Item L-34

"Farrel-Birmingham Flood Report." Bulletin No. 60. Farrel-Birmingham Co., Inc. 11 pages. This is a photographic account of the damage sustained by the company's Ansonia and Derby plants in the recent New England flood, and the post-mortem efforts to get production back to normal.

Readers' Service Item L-35

"Look to Linde for Silicones." Linde Air Products Co., division of Union Carbide & Carbon Corp. 4 pages. Descriptions of the various silicones made by the company are given in this folder.

Readers' Service Item L-36

"Two Remarkable New Materials." Barrett Division, Allied Chemical & Dye Corp. 4 pages. Molding characteristics and physical properties of new Plaskon nylon molding compounds 8200 and 8201 are presented in this illustrated bulletin. Plaskon polyethylene lubricants are also described.

Readers' Service Item L-37

"Transparent and Reinforced Plastics Parts." Swedlow Plastics Co. 8 pages. An illustrated brochure describing the firm's engineering and production facilities.

Readers' Service Item L-38

"Auto-Vac Drape and Vacuum Forming Machines." Bulletin 55. Auto-Vac Co. 8 pages. An illustrated brochure showing the construction features and operating cycles of the machines, plus their industrial and packaging applications.

Readers' Service Item L-39

Book Reviews

"ASTM Proceedings." Vol. 54, 1954. American Society for Testing Materials, Philadelphia, Pa. 1412 pages. Price, $12.00.

The technical achievements of the ASTM during 1954 are recorded in this annual volume. Included are a summary of the proceedings of the 57th annual meeting, listing by title and author the program for each of 36 sessions; 68 reports of the Society's technical committees, in addition to 37 technical papers and accompanying discussions; separate listings of all symposiums published as Special Technical Publications and all papers published in the ASTM Bulletin; and complete subject and author indices.

"Consulting Services." Association of Consulting Chemists & Chemical Engineers, Inc., 50 E. 41st St., New York, N. Y. Paper, 6 by 8¾ inches, 144 pages. Price, $1.00.

This 15th edition of the handbook affords a handy tool for those seeking a consultant's advice or services. Divided into three sections, the book lists alphabetically the various chemical fields with numerical references to specialized and qualified firms; gives detailed data on the firms' locations, personnel, and activities; and contains an alphabetical index of the firms.

"Hawley's Technical Speller." Gessner G. and Alice W. Hawley. Reinhold Publishing Corp., New York, N. Y. Cloth, 5 by 7½ inches, 146 pages. Price $2.95.

This small volume is a compilation of more than 8,000 technical words selected from the vocabularies of chemistry, physics, engineering, and the other sciences. The words are arranged alphabetically with syllabic divisions, and are undefined. A brief explanation of the derivation of chemical technology is included. The specialist, with his basic background and his own reference books, will not find this speller too helpful in his work. But others on the fringes of a technical vocation, such as secretaries, teachers, and authors, will.

"Plastics and Building." E. F. Mactaggart and H. H. Chambers. Philosophical Library, Inc., 15 E 40th St., New York, N. Y. Cloth, 7½ by 10¼ inches, 189 pages. Price, $12.00.

This British book presents a broad picture of the plastics industry, covering chemistry, manufacture, and applications. Special emphasis is placed, however, on the use of plastics in the building and allied trades.

After a brief and illustrated description on molecular structure, the various plastics fabrication techniques are considered including the practical problems of adhesion and lamination. A chapter is devoted to materials and production statistics, including a prediction of futures and trends.

Chapter 18 is concerned with designing in plastics, and includes a graphic chart on material properties which would be of interest to the design engineer. A glossary of technical terms and a list of trade names form useful appendices to the book.

"Designing for Industry." F. C. Ashford. Philosophical Library, Inc., 15 E. 40th St., New York, N. Y. Cloth, 5¾ by 8¾ inches, 232 pages. Price $7.50.

Written by a prominent English designer, this book covers all aspects of product design and development. The esthetics of design are considered in the first chapter, including function and good taste. Executive aspects are covered next, including practice, visualization, drafting, and modelmaking.

The two other sections are devoted to material aspects and marketing. Choice of the proper material, processing techniques, and finishing operations are covered in detail. With specific reference to plastics; 15 pages describe the various materials available, molding and fabricating techniques, and finishing.

The essential theme running throughout the book emphasizing the material aspect. Improper choice of materials render the designer's work useless, and imperil the industry's position in a competitive market.

"Instruments for Measurement and Control." Werner G. Holzbock. Reinhold Publishing Corp., 430 Park Ave., New York, N. Y. Cloth, 6 by 9 inches, 371 pages. Price, $10.00.

This book describes and illustrates all of the more recent devices used to measure and control temperature, moisture, pressure, flow, liquid level, density, viscosity, and speed. Written in non-mathematical language, it is intended as a reference work for researchers in the fields of instrumentation and quality control.

Eight chapters are devoted to the instruments mentioned above, and other chapters cover such topics as material specification analysis, automatic controller action, electric controllers, self-operated controllers, time function controllers, and final-control elements. A special chapter on trends discusses the development of centralized systems, miniaturization, and digital computers.

Schematic reproductions of all types of instruments are included. Other technicians not directly concerned with instrumentation should find it useful as a review of physical elements.

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Abstracts of Important Articles

MATERIALS

"Plasticizers for PVC Resins," Charles J. Knuth and Paul F. Bruins, *Ind. Eng. Chem.*, 47, 8, 1572 (Aug. 1955).

Preparation and evaluation of diesters, dibutyl ester polymers, and ester-lactams of itaconic acid are presented in this article. Property data on PVC compounds plasticized with these materials are given in tabular form.

"Chemistry and Technology of Urea Resins. II. Urea-formaldehyde Condensation in Alcoholic Solvents," H. Fahrenhorst, *Kunststoffe*, 45, 6, 219 (June 1955).

In this second article are considered known and hitherto unknown relationships between the conditions for producing alcohol-modified urea resins and their properties from the viewpoint of varnishes. The author describes model reactions based on the electron theory to explain the process of methylol etherification, and a model experiment on thermal resinification of the crystalline dibutyl ether of dimethylol urea. (In German).

"Quantitative Determination of Phenol and o-Cresol in Mixtures," M. Krahl, *Kunststoffe*, 45, 6, 224 (June 1955).

A method for the quantitative determination of phenol by formaldehyde condensation to Resite has already been described. It serves to determine those components in alkaline liquid resins used as glues in hardboard manufacture that do not precipitate at pH 4.5. The present method to determine o-cresol in mixtures with phenol also is based on the condensation of formaldehyde when the process follows a different course for the two components. (In German).

"The New Polyethylenes," J. A. Neumann and F. J. Bockhoff, *Modern Plastics*, 32, 12, 117 (Aug. 1955).

Properties, fabrication methods, and applications for the new, low pressure polyethylenes are discussed generally in this article.

"Considerations in the Design of Plastics Structures for Light Weight," C. H. Adams, W. N. Findley, and F. D. Stockton, *Modern Plastics*, 32, 12, 139 (Aug. 1955).

A mathematical method is described for selecting the optimum material to satisfy service conditions. A simple strength-to-weight ratio is unsatisfactory for predicting minimum weight of a structure.

"The Synthesis of Benzol Ethers of Polyvinyl Alcohol," S. N. Yshakow and E. M. Lavrentieva, *J. Applied Sc. (Moscow)*, 28, 4, 406 (April 1955).

The conditions for producing benzyl ethers of polyvinyl alcohol by interaction of alkaline derivatives of PVA (obtained by the action on PVA of aqueous solutions of sodium hydroxide) with benzyl chloride were studied. Ethers were obtained with 10-80% mole substitution of benzoxy groups, and it was found that the concentration of NaOH determines the degree of substitution. With 30% mole substitution, the tensile strength and elongation of the product are somewhat lower than those of the original PVA. The vitrification temperature decreases with the degree of substitution, dropping to 13° with 80% mole substitution in comparison with 85° for the original PVA. (In Russian).

"Plasticizer Migration. II," G. Beck, *Kunststoffe*, 45, 6, 230 (June 1955).

Here, for the first time, figures are given to indicate the migration of plasticizers between plasticized and unplasticized PVC films, with various commonly-used plasticizers and different K values of the PVC material being taken into account. Important pointers are offered for practical applications of combinations of soft and hard PVC films. (In German).

"Design of Plastic Structures for Complex Static Stress Systems," A. A. MacLeod, *Ind. Eng. Chem.*, 47, 7, 1319 (July, 1955).

Design equations have been developed from the theory of linear viscoelasticity, with the time-dependent properties of plastics characterized by two easily-measured parameters. Equations are given for deflection of clamped beams and disks, torsion of rods, buckling of columns, and diametral expansion of pipe and tanks under hydrostatic pressure.

Requests for copies, reprints, or further information on any article abstracted in this department should be addressed to the publisher of the magazine where the article appeared. A complete listing of the publishers and addresses of these magazines will be printed here quarterly.
—The Editor

"Chemistry and Technology of Urea Resins. I. The association Theory of Urea Resinification," H. Fahrenhorst, *Kunststoffe*, 45, 2, 43 (Feb. 1955).

The aminoplasts (including urea and melamine resins) are low molecular compounds which simulate macromolecular structure through a high degree of molecular association. The contradiction between existing theory and practical experience on the formation of urea resins are considered, and it is shown why neither the methylol group in its classic formulation nor the methylene bond in urea radicals plays such an important part in actual resinification as to provide an adequate explanation of the resin properties of solubility, hardenability, or ability to react with alcohols. The author explains his own views by means of a model experiment of the condensation of urea-formaldehyde in 1:1 mole ratio in slightly alkaline n-butanol solution in the absence of water. The first reaction product is not monomethylol urea, but is held to be a primary addition product which gradually rearranges to the more stable methylol form. These findings are used to explain the specific association ability of urea molecules and the bilateral association process (association of resin molecules and competitive association of solvent molecules) assumed to be characteristic for the formation of carbamide resins. The binding forces in this association are probably semi-polar bonds, not the classic chemical valence forces, and the author offers an interpretation based on the electron theory. (In German).

"Polymerization of Methylmethacrylate in the Presence of Colors," Z. K. Jelinek, *Plaste u. Kautschuk*, 2, 6, 131 (June 1955).

In polymerizing methylmethacrylate in the presence of soluble colors, the latter frequently inhibit polymerization, are changed by the conditions of the process, or both conditions arise at the same time. Both effects are marked when benzoyl peroxide is employed as the initiator. On the other hand, coloring has been found to be very satisfactory with Porofor N (azo-isobutyric acid dinitrile) as initiator, although polymerization is retarded by the same inhibitors as with benzoyl peroxide so that the amount of Porofor N must be increased. This has been done empirically, since the exact quantitative relation between rate of polymerization or amount of initiator, and the inhibition caused by a color, hitherto was not known. With the aid of an equation worked out earlier for the activity of the monomer, a workable formula was developed so that the amount of initiator needed to restore the rate of polymerization could be determined if the retarding factor of a dye was known. (In German.)

"New Kinds of Macromolecules," H. W. Melville. *Trans. Plastics Inst.*, 23, 53, 146 (July 1955).

The problems involved in the synthesis of two new types of macromolecules, the so-called linear block copolymer and

branched chain molecules, are considered, with the discussion being confined largely to vinyl types of molecules. Among methods of non-random or block copolymer synthesis that are treated are supersonic irradiation of polymers, synthesis with weak links, synthesis by the terminal group method, and two-phase synthesis. The occurrence, control, and effect on properties of branching were demonstrated by the example of polyethylene and PVC; and the detection of branching by radio-active grafting and synthesis of branched chain molecules by the example of polystyrene.

"High Styrene Copolymers," L. V. de la Torre, *Rev. Plasticos*, 6, 34, 189, (July-August 1955).

The chemistry and properties of a number of high styrene copolymers are briefly reviewed, including copolymers with butadiene, fumaronitrile, acrylonitrile, divinylbenzene, unsaturated polyesters, maleic anhydride, and drying oils. (In Spanish.)

"Heat-Resistant Polyester Laminates," W. Cummings and M. Botwick, *Ind. Eng. Chem.*, 47, 7, 1317 (July, 1955).

Diallyl bicycloheptene dicarboxylate and triallyl cyanurate were the only two polyester-glass cloth laminates to show measurable flexural strength after 192 hours at 500° F. Mixtures of these two monomers give laminates that resist heat-aging better than do either one alone.

"Industrial Prospects for Organic Fluorine Compounds," M. Stacey, *Rubber & Plastics Age (London)*, 36, 8, 465 (August 1955).

The author mentions some points regarding the fundamental chemistry and possible applications of a few types of fluorine compounds now being investigated, such as chlorofluoro compounds, olefinic types, and compounds resulting from the addition of alcohol to olefinic types. At the University of Birmingham, a method has been discovered of fluorinating benzene so as to give a series of compounds. In these, the hydrogen atoms can be eliminated to give fluorohexadienes. By copolymerizing them with other fluoro-olefinic compounds such as perfluorobutadiene or perfluorocyclobutane, interesting series of new polymers might be obtained. Developments in the United States are mentioned.

EQUIPMENT

"Unusual Mold Design Produces Precision Moldings," Rudolph Lorenz, Jr., *Modern Plastics*, 32, 12, 124 (Aug. 1955).

Slotted pressure plates for IBM machines requiring close tolerances are now molded from styrene copolymer rather than machined from 61S aluminum flat stock.

"Mold Design for Injection Molding Machines," H. Gastrow. *Kunststoffe*, 45, 7, 317 (July 1955).

Molds for parts with internal and external undercuts are described. (In German.)

"Molds and Appliances for the Vacuum Process," Von Horst Picht and G. Matulat, *Kunststoffe*, 45, 7, 313 (July 1955).

In view of the growing importance of the vacuum method, it is considered useful to keep posted on developments and to give examples of its application. The paper gives a number of suggestions as to the design of molds and apparatus for both negative and positive forming. (In German.)

"Practical Do's and Don'ts in Tool Design," J. Butler, *Trans. Plastics Inst.*, 23, 53, 173 (July 1955).

The material presented comes under two heads; basic types of compression molds are dealt with in Part I, while Part II covers design of tools for transfer work, feeds and gates, causes and significance of frictional heat in transfer molding, causes of flashing, and gives pointers on vents, ram and pin friction, and split molds. The strength of moldings is treated briefly.

PROCESSING

"Casting Ethoxyline Resins," A. Rivat-Labousse, *Ind. Mat. Plastiques*, 7, 7, 21 (July-August 1955).

There are two types of ethoxy casting resins; those that are liquid at ordinary temperatures and harden after incorporation of a hardener without requiring additional heat; and solid resins which first must be melted. The differences in methods of processing are briefly discussed, as are the molds and release agents to be used. (In French).

"Polyethylene Pipes," F. N. Pickett, *Rubber Age*, (London), 36, 7, 419 (July 1955).

The possibility is suggested of applying the Delavaud iron pipe spinning process and machines to the production of plastic pipe, particularly the new low-pressure Ziegler polyethylene.

"Further Results of Work at the Aachen Institute for Plastics Processing," H. Peukert, *Kunststoffe*, 45, 7, 290 (July 1955).

The recent investigations carried out at the Aachen Institute for Plastics Processing in Industry and Crafts are briefly reported, and include hot stretching, infra-red heating, hot-gas welding of cellulose acetate, and glueing and screwing of plastics. Other work now in progress relates to the welding, cementing, and flame-spraying of polyethylene. (In German.)

"Recent Methods for Processing Styropor," F. Stastny, *Plastverarbeiter*, 6, 7, 242. (July 1955).

In Germany, two new types of Styropor expandable polystyrene beads have been developed in addition to Styropors K and P. These are Styropor K 194 DS with limited flame-resistance, and Styropor K 172 DS with good flame resistance, like that of PVC. The author describes methods for processing all these various products; cementing Styropor with suitable adhesives; combining the two flame-resistant types to obtain products with different properties; making molded goods with hard or flexible polyester surfaces, with soft PVC surfaces, or other materials; and making unexpanded preforms of Styropor P. (In German).

"Welding and Hot-Shaping of Saran Fabric," L. Kraft, *Kunststoffe*, 45, 7, 272 (July 1955).

Early experiments quickly led to the elimination of the hot-gas welding and heat impulse methods, so that only the hot-wedge and high frequency processes are considered here. Preliminary experiments on welding saran fabric to PVC film were conducted, and it appears that to obtain a satisfactory joint it is necessary to either interpose a third material like Moltoprene Foam, or to apply PVC paste to both saran and the PVC film. Hot-forming was confined mainly to deep-drawing, which seems to be suitable for producing covers with perpendicular sidewalls. Attempts to hot-shape saran by blowing gave unsatisfactory results, and testing in this direction was discarded. (In German.)

"Behaviour of Rigid Thermoplastics in Non-Machining Processes," A. Kleine-Albers, *Kunststoffe*, 45, 7, 276 (July 1955).

The thermoplastics mainly dealt with are rigid PVC and the acrylics, and the processes include shaping by bending (of pipes), deep-drawing, folding edges of sheets, blow-molding, vacuum forming, and forming by impact presses. Machining processes, and forming by molding of material in powder or granulated form are excluded. The results of experiments on the behaviour of plastics above their hardening temperature are discussed, with special reference to their strength in the hot-stretched state. The role of temperature and molecular weight in hot-stretching, diagrams of repeated stressing, and optical effects are also considered. (In German.)

"Two-Tone Finishing of Plastic Leathers," H. Ploenes, *Kunstoff-Rundschau*, 2, 7, 245 (July 1955).

Various methods of obtaining two-tone effects on imitation leathers made from plastics are briefly described, including "antiquing" with the aid of a color doctor; shading, in which a film of paint is "wiped" into the sunken parts of the design with the aid of elastic friction rolls; ink-embossing; and overcoloring or topping. (In German.)

"Hot-Gas Welding of Rigid and Plasticized PVC," H. Peukert, *Kunststoffe*, 45, 7, 257 (July 1955).

Some of the problems arising in hot-gas welding of rigid and plasticized PVC with welding rods are dealt with, chiefly the effect of welding rod composition on weld strength when used to join rigid PVC parts. Rods were prepared from rigid PVC and also from PVC plasticized with from 2-20% of tricresylphosphate, and tests were carried out on rigid PVC sheets of different thicknesses. It was found that welding temperatures above those customarily in use could be employed with advantages as weld stress is reduced, pressure can be lower, and welding speed is increased. Plasticizer-free rods offer the advantages of better weld strength, especially at elevated temperatures, and greater heat resistance because of higher softening point, while at the same time their chemical resistance is similar to that of the parts welded. Tests were also made with three-mm. thick plasticized PVC sheet welded with rods of the same material. It was found that the best working conditions were temperatures of 250-300° C. and speeds of 60-110 mm./min. (In German.)

"Study of High Frequency Welding of Plastics," B. Fradin, *Plastiques Informations*, 33 (July 1, 1955).

This initial article of a series on the practical aspects of high-frequency welding of plastics considers the principles of the process and the mathematics involved. (In French).

"Welding of Plasticized PVC Sheet," K. Oberbach, *Kunststoffe*, 45, 7, 266 (July 1955).

The most suitable methods of joining PVC sheet less than two mm. thick include the heat impulse, hot wedge, and high-frequency methods. These processes, as carried out on representative German machines, are described and discussed, with the optimum conditions for high-frequency welding of plasticized PVC sheet receiving special attention. In the hot wedge method, a sewing machine type of device is used in which the parts of the plastic to be welded are softened by being passed over the heated tip of a copper wedge and then being pressed together by rolls. (In German.)

APPLICATIONS

"Fine Chemical Plants," John R. Yost, Jr., and A. J. Sargent, *Ind. Eng. Chem.*, 47, 7, 1349 (July, 1955).

Product contamination and corrosion have increased the use of plastics in process equipment such as filter media, gaskets, pipes, valves, and storage tanks.

"Textile Fiber Plants," W. A. Haldman and E. F. Wesp, *Ind. Eng. Chem.*, 47, 7, 1359 (July, 1955).

Early applications of plastics were concerned primarily with corrosion resistance and maintenance of dimensional stability. Research is being conducted on the possibility of reducing metallic contamination of process materials. Here, the biggest drawback is, again, temperature limitations.

"Evaluating Plastics for the Chemical Industry," C. Howard Adams and R. A. McCarthy, *Ind. Eng. Chem.*, 47, 7, 1294 (July, 1955).

Properties of plastics are compared with those of other construction materials to aid the industrial designer. Environmental conditions affecting plastics are discussed along with economical considerations and recommendations for specific applications.

"The Impact of Plastics on the Paper Industry," F. L. Hudson. *Trans. Plastics Inst.*, 23, 53, 164 (July 1955).

In this article are briefly reviewed the history of paper-making, the use of paper in plastics (for laminates), and the use of amino resins in the paper industry to improve the quality of poorer grades of paper fibers.

"Synthetic Resin Cements in Chemical Plant Construction," H. Hughes, *Trans. Plastics Inst.*, 23, 53, 219 (July 1955).

The author first deals briefly with the pros and cons of hydraulic, rubber-latex, sulfur, and silicate cements as corrosion resistant materials, before concentrating on the properties and limitations of suitable resin cements, such as phenolformaldehyde cements, cements from furfural alcohol either alone or mixed with furfural, phenol and furfural cements, and cements from cashew nut shell liquid. In his opinion, the most important work to be done on corrosion-resistant plastics cements is to improve their resistance to nitric acid and oxidizing agents.

"Fabrication and Uses of Rigid Vinyl Sheet," W. E. Martin, *Brit. Plastics*, 28, 8, 328 (August 1955).

The physical and chemical properties of Cobex rigid vinyl sheet are compared with those of cellulose nitrate and cellulose acetate, polyethylene, polystyrene, and nylon. The processes of sheet-forming, male force molding, vacuum forming, hot air and high frequency welding, finishing, antistatic treatment, and printing are dealt with, and some present uses of the materials are discussed. Mention is made of experiments being undertaken in using soft/hard laminate sheet as ducting material in coal mines. The author foresees very considerable expansion in packaging, roof-lighting under non-tropical conditions, and advertising uses. Recent developments in the United States are touched on.

"Piping, Valves, and Ducts," Raymond B. Seymour, *Ind. Eng. Chem.*, 47, 7, 1335 (July, 1955).

Material selection may vary with the specific plant, and necessitates a sound knowledge of the properties of plastics. Successful applications include pipelines in excess of 10 miles in length, valves operating at temperatures above 400° F., and exhaust systems with areas greater than 50,000 square feet. Each plastic material is considered separately.

"Clear and Transparent Plastics Film in Horticulure," W. Behrens, *Kunststoffe*, 45, 7, 315 (July 1955).

Experiments carried out for two years with transparent PVC, cellulose acetate, and cellophane sheet in the construction of cold frames and green houses gave satisfactory results. If the plastics withstand long-term exposure to extremes of weather, horticulture should provide an important outlet for them in West Germany where the area under glass is about 12,000,000 square meters. It is suggested that the plastics industry should indicate the transparency, heat conductivity, and tear resistance of each sheet of clear or transparent plastic to be used for horticultural purpose: (In German.)

"Tergal, Applications and Conditions for Use," P. Muller, *Plastiques Informations*, 25 (July 1955).

The polyester fiber known in America as Dacron and in England as Terylene, is now being produced in France under the name of Tergal. Its properties, applications and processing are discussed. (In French.)

"Plastics and Packaging," J. A. Vega, *Rev. Plasticos*, 6, 34, 197 (July-August, 1955).

The author discusses, in turn, the packaging requirements for various types of goods, (referring particularly to the American specification MIL-P-116B); the most suitable plastics and methods of utilizing them in protecting such different products as cosmetics, machinery parts, and airplane motors; and tests to permit the selection of the most appropriate plastic for a given packaging purpose. (In Spanish.)

GENERAL

"Financial Management Through Costing and Budgetary Control," H. Senior and J. Oldham, *Trans. Plastics Inst.*, 23, 53, 239 (July 1955).

Standard costing and budgetary control are modern management tools of economic organization and planning designed to insure continuing profit. The authors explain the setting-up, operation, and advantages of a budget, the necessity for and the application of standard costing, and the presentation of information. Typical budgets are appended.

Patent Digest

Materials

Free-Flowing, Non-Caking Compositions. No. 2,716,094. Henry L. Morrill, Clayton, Mo. (to Monsanto Chemical Co., St. Louis, Mo.).

About 15-40% of the composition by weight comprises a hygroscopic water-soluble polyelectrolyte which consists essentially of salts of polymers of acrylic acid, polyacrylic acid, polymethacrylic acid, unsaturated polycarboxylic acid, and copolymers of a mono-olefinic monomer of alkyl esters, amines, and amides. The rest of the composition consists of finely divided particles of attapulgite and acid-modified sub-bentonite clay.

Acrylonitrile Polymer Solutions and Process for Shaping the Same. No. 2,716,093. William R. McClellan, Kennett Square, Pa. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

The aqueous solution contains 8-25% acrylonitrile polymer by weight; 32-50% by weight of a salt, which is a solvent for acrylonitrile when in solution; 15-35% by weight of a neutral organic oxy compound which is liquid at room temperature; and 5-35% by weight of water.

Methylcellulose Composition and method. No. 2,716,072. William J. Hanson, Long Beach, Calif. (to Dow Chemical Co., Midland, Mich.).

This composition comprises 30-70% methylcellulose by weight, 20-50% by weight of sodium acetate, and 10-20% by weight of a solid synthetic anionic wetting agent. The composition dissolves in water over a temperature range of 0.40° C.

Acrylonitrile Polymers Stabilized with Certain Formals and Acetals. No. 2,716,095. George W. Stanton and Forrest A. Ehlers, Walnut Creek, Calif. (to Dow Chemical Co., Midland, Mich.).

The composition consists of 60% by weight of polymerized acrylonitrile, the balance being another monoethylenically-unsaturated compound copolymerized with acrylonitrile. The stabilizing agent contains 1-20% by weight of a compound containing chlorine, methoxyl, ethoxyl, and methoxy-ethoxyl radicals.

Polymerization of Vinyl Chloride with 1,1,1-Tribromo-2-Methylpropanol-2 Modifier. No. 2,716,112. Dexter C. Seymour, Wyckoff, N. J. (to United States Rubber Co., New York, N. Y.).

PVC latex is produced by polymerizing vinyl chloride at 25-60° C. in aqueous emulsion, and in the presence of an initiator and 0.1-8% by weight of 1,1,1-tribromo-2-methylpropanol-2.

Polymerization of Vinyl Chloride with a Benzenesulfonyl Chloride Modifier. No. 2,716,111. Dexter C. Seymour, Wyckoff, N. J. (to United States Rubber Co., New York, N. Y.).

Vinyl chloride is polymerized at 25-60° C. in the presence of an initiator and 0.1-8% of benzenesulfonyl chloride, together with its monomethyl and monobromo derivatives.

Vinyl Chloride Resins Stabilized with a Mixture Containing a Phenolate and a Polyvalent Metal Salt of a Fatty Acid. No. 2,716,092. William E. Leistner, Brooklyn, and Arthur C. Hecker, Richmond Hill, N. Y.

The stabilizer includes a barium hydrocarbon-substituted phenolate and a cadmium salt of a fatty acid which are mixed uniformly with the PVC.

Preparation of Vinyl Fluoride and 1,1-Difluoroethane and Catalyst Therefor. No. 2,716,143. Benjamin F. Skiles, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

The catalyst consists essentially of the reaction product of HF and ammonium sulfate particles which have been heated in the presence of nitrogen. By continuing the reaction at a higher temperature, and substituting acetylene for nitrogen, vinyl fluoride and 1,1-difluorethane can be separated from the gaseous mixture leaving the bed.

Printed copies of patents are available from the Commissioner of Patents, Washington 25, D. C. Price, 25c each.

—The Editor

Preparation of Vinyl Fluoride and Catalyst Therefor. No. 2,716,142. Benjamin F. Skiles, Wilmington, Del. (to E. I. du Pont de Nemours & Co., Wilmington, Del.).

A gaseous mixture of hydrogen fluoride and nitrogen is passed through a bed of zinc oxide particles which is heated to 65-200° C. When HF fumes begin to escape, the temperature is raised to 300-350° C., and the gaseous mixture changes to HF and acetylene. The vinyl fluoride is then separated from the gaseous mixture leaving the bed. The catalyst consists essentially of the reaction product of HF and zinc nitrate, obtained by carrying out only the first step of the process outlined above.

Polymerization of Vinyl Chloride with Trithioformaldehyde Regulator. No. 2,716,644. Verne G. Simpson, Wyckoff, N. J. (to United States Rubber Co., New York, N. Y.).

Vinyl chloride is polymerized in the presence of a free radical-producing polymerization initiator and 0.1-8% by weight of trithioformaldehyde. The reaction is carried out at a temperature of 25-60° C.

Polymerization of Vinyl Chloride with N-Chlorophthalimide Modifier. No. 2,716,110. Dexter C. Seymour, N. J. (to United States Rubber Co., New York, N. Y.).

Vinyl chloride is polymerized at 25-60° C. in the presence of an initiator and 0.1-8% of N-chlorophthalimide.

Polymeric 1-Chloro-1,2-Difluoroethylene. No. 2,716,109. Robert P. Ruh and Marion R. Rector, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

A new synthetic resin consists of a solid polymer of 1-chloro-1,2-difluoroethylene which is readily fusible and soluble in common organic solvents. It also is substantially inert to oxidation, thermal decomposition, acids, alkalies, and moisture.

Multicomponent Interpolymers of Vinylidene Cyanide. No. 2,716,105. Harry Gilbert, Cuyahoga Falls, and Floyd F. Miller, Wadsworth, O. (to B. F. Goodrich Co. Akron, O.).

Vinylidene cyanide is copolymerized with a conjugated aliphatic diene and another mono-olefinic monomer.

Epoxy Resins from Alkyl Phenol Novolac Resins. No. 2,716,099. Theodore F. Bradley, Orinda, and Herbert A. Newey, Lafayette, Calif. (to Shell Development Co., Emeryville, Calif.).

Epichlorhydrin is condensed in a basic medium with the novolac resin of an aldehyde and a mononuclear monohydric alkylphenol. The mixture is reacted at about 60-150° C., with the addition of alkali metal hydroxide.

Multicomponent Polymers of Vinylidene Cyanide. No. 2,716,106. Harry Gilbert, Cuyahoga Falls, and Floyd F. Miller, Wadsworth, O. (to B. F. Goodrich Co., Akron, O.).

Vinylidene cyanide is copolymerized with two other mono-olefinic monomers.

Multicomponent Interpolymers of Vinylidene Cyanide. No. 2,716,104. Harry Gilbert, Cuyahoga Falls, and Floyd F. Miller, Wadsworth, O. (to B. F. Goodrich Co., Akron, O.).

Vinylidene cyanide is copolymerized with two conjugated aliphatic dienes. The former is derived from monomeric vinylidene cyanide which has a melting point of 9-9.7° C., and is able to undergo instant homopolymerization in water at room temperature to produce a solid resin.

Treatment of PVC with Lithium Aluminum Hydride. No. 2,716,642. John Daniel Cotman, Jr., Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

A homopolymer of vinyl chloride having a degree of polymerization in excess of 100 is reacted with lithium aluminum hydride in the presence of an anhydrous aliphatic ether. Anhydrous and oxygen-free conditions must be maintained throughout the reaction.

Hydroxylated resins from PVC. No. 2,716,643. John Daniel Cotman, Jr., Springfield, Mass. (to Monsanto Chemical Co., St. Louis, Mo.).

A homopolymer of vinyl chloride is reacted with lithium aluminum hydride in the presence of 0.05-0.5 mol of oxygen per mol of homopolymer. The reaction is carried out in solution with anhydrous ether.

Equipment

Apparatus for Expanding Materials. No. 2,715,761. Ralph W. Dougherty, North Little Rock, Ark. (to Visking Corp., Chicago, Ill.).

The apparatus consists of a spreader unit having a pair of end discs spaced at a spreading angle. A plurality of uniformly-spaced coil springs are attached to the discs and form the peripheral wall. The unit is rotatable, and the springs adjust the varying distances between the discs. The web is then fed continuously onto the peripheral wall.

Method and Apparatus for Forming Articles from Plastic Materials. No. 2,715,751. Walter Carl Weber, Toledo, O. (to Owens-Illinois Glass Co., Toledo, O.).

The apparatus consists of a finishing mold moveable in a closed path, a neck mold, an opening and closing means, an injection station, a parison mold, an intermediate mold, and a means for supplying air under pressure. Plasticized material is injected into a mold to form a parison, which is partially expanded into a second mold by a change in fluid pressure. The parison is expanded to final form in the finishing mold.

Heat Sealing Apparatus. No. 2,715,934. Reinhardt N. Sabee, Appleton, and Willard L. Wogsland, Neenah, Wis. (to Reinhardt N. Sabee).

An appartus for heat-sealing thermoplastic webs consists of a frame, a supporting and carrying means, an elongated heating element, and a second heating member. The heating elements contact the upper surface of the web.

Processing

Bleaching Polyacrylonitrile Fibers. No. 2,720,440. John G. Wallace, Lewiston, N. Y. (to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.).

Polyacrylonitrile fiber is bleached by subjection to a solution comprising an agent from the group consisting of performic acid, hydrogen peroxide and mixtures thereof, dissolved in a solvent containing at least 75% formic acid by weight.

Polyethylene Coating and Method of Applying the Same. No. 2,716,075. Randolph A. Wiese, New York, N. Y. (to the United States of America, as represented by the Atomic Energy Commission).

Successive thin layers of resorcinol-phenol-formaldehyde in an organic solvent, phenol-formaldehyde-rubber cement, polyethylene and powdered silica, and polyethylene are applied in that order and flame sprayed.

Method of Coating Paper with Crystalline Sarans. No. 2,716,074. William F. Mick, Midland, and Oliver B. Amley, Sanford, Mich. (to Dow Chemical Co., Midland, Mich.).

Crystalline saran is continuously melted and fed into a pressure zone where it comes in contact with a strip of paper. The uncoated side is wetted thoroughly while the polymer is still amorphous, and the sheet is subjected to a temperature of 55° C. at which point the polymer crystallizes rapidly.

Felted Fibrous Cellulosic Structural Board Having Rigidifield Portion and Method of Making Same. No. 2,716,617 Herbert F. Austin, Jr., Great Neck, Moses Konigsberg, Roslyn, John M. Morrison, New York, and Frank C. Campins, Pelham, N. Y. (to Jam, Wichita, Kans.).

The process comprises applying a high-penetrating, low viscosity resin dispersion to the surface of a preformed porous board. Upon drying, the rigid portion extends inward from the surface to a substantial depth.

Applications

Plastic Bandage or Adhesive Tape and Process of Manufacture. No. 2,720,477. Talbot A. Lancaster, Canterbury, Conn. (to Plastic Film Corp., Inc., Plainfield, Conn.).

A plastic film is infibrillated on at least one surface by a fibrous material which is imbedded only partially into the film's thickness. The fibrous material has hair-like fibers lightly compacted in unthreaded form and oriented substantially in one general direction to inhibit stretchability of the film in that direction, without correspondingly increasing the tearability in the transverse direction.

Trifluorochloroethylene Surfaced Sheeting Roller. No. 2,715,879. Hilon W. Sawyer, Nutley, N. J. (to Wallace & Tiernan, Inc., Belleville, N. J.).

A roll for working tacky or sticky substances combines a rigid cylindrical core having a roughened peripheral surface with a tubular covering layer of Trifluorochloroethylene molded on. The end portions are interlocked with end plates to prevent longitudinal and circumferential expansion of the covering layer.

Dielectric Material. No. 2,716,190. Edward B. Baker, Midland, Mich. (to Dow Chemical Co., Midland, Mich.).

This patent concerns a microwave lens which is composed of a low-density dielectrical material consisting of rod-shaped magnesium particles dispersed in a foamed polystyrene matrix.

Cover Construction for Storage Batteries. No. 2,716,147, Clayton A. Laughlin, Minneapolis, Minn. (to Northwest Plastics, Inc., St. Paul, Minn.).

A flexible plastic filler tube is mounted for slideable vertical movement. One end projects into the battery, and the other extends outward.

Plastic Insulated Bayonet Base. No 2,716,742. Adolph C. Szafran, Euclid, and Robert L. Imboden, Lyndhurst, O. (to General Electric Co., Schenectady, N. Y.).

This patent describes a base for electrical devices, and consists of a cylindrical shell, a means for indexing the base in a socket, and a plastic web enclosing the bottom. Primary bosses project from the outer surface of the web, and secondary bosses extend laterally to form an arcuate path.

Domestic Production and Sales of Plastics and Resin Material, May and June, 1955

Following are the partly estimated and revised statistics for the domestic production and sale of plastics and resinous material during the months of March and April, 1955. Units listed are in pounds, dry basis unless otherwise specified. Data on alkyds and rosin modifications have not been included since their use is primarily limited to the protective coating industry.

June production and sales show a slight tapering-off from last month's figures; however the overall picture remains unchanged.

	May		June	
	Production	Sales	Production	Sales
Cellulose Plastics:[1]				
Cellulose acetate and mixed ester:				
Sheets, under 0.003 gage	1,253,143	1,359,224	1,707,652	1,767,138
Sheets, 0.003 gage and over	1,349,317	1,185,311	1,434,461	1,365,705
All other sheets, rods, and tubes	644,967	563,701	760,460	718,989
Molding and extrusion materials	7,758,301	7,464,172	7,723,252	7,458,227
Nitrocellulose sheets, rods, and tubes	402,714	396,181	415,174	378,722
Other cellulose plastics	560,509	609,946	333,259	278,710
TOTAL	11,968,951	11,578,535	12,374,258	11,967,491
Phenolic and Other Tar-Acid Resins:				
Molding materials[1]	17,706,724	16,097,449	17,540,389	17,739,914
Bonding and adhesive resins for—				
Laminating (except plywood)	5,986,314	4,467,890	5,770,941	4,551,788
Coated and bonded abrasives	1,428,918	1,387,774	1,648,765	1,748,940
Friction materials (brake linings, clutch facings, and similar materials)	2,111,997	2,097,977	2,787,385	2,500,850
Thermal insulation (fiber glass, rock wool)	4,170,813	4,059,745	5,162,480	5,017,941
Plywood	3,434,167	2,763,650	3,966,008	3,311,631
All other bonding and adhesive uses	2,135,943	2,126,287	2,269,384	2,135,288
Protectice-coating resins, unmodified and modified except by rosin	2,431,254	2,061,582	2,427,490	2,482,534
Resins for all other uses	2,900,993	2,541,222	2,660,619	2,495,115
TOTAL	42,307,123	37,603,576	44,233,461	41,984,001
Urea and Melamine Resins:				
Textile-treating and textile-coating resins	3,377,497	3,186,324	3,049,339	2,918,617
Paper-treating and paper-coating resins	1,744,910	1,697,081	1,636,475	1,280,207
Bonding and adhesive resins for—				
Plywood	8,399,031	7,560,602	8,209,169	7,673,732
All other bonding and adhesive uses, including laminating	1,908,848	1,970,105	2,407,088	2,441,859
Protective-coating resins, straight and modified	3,548,538	2,651,434	3,522,095	2,479,299
Resins for all other uses, including molding	7,208,867	6,804,591	5,929,419	5,330,487
TOTAL	26,187,691	23,870,137	24,753,585	22,124,201
Styrene Resins:				
Molding materials[1]	35,470,807	31,816,171	34,604,231	28,944,532
Protective-coating resins, straight and modified	9,059,629	7,720,016	8,820,871	7,924,761
Resins for all other uses	7,078,697	7,532,005	7,668,970	6,437,161
TOTAL	51,609,133	47,068,192	51,094,072	43,306,454
Vinyl and Vinyl Chloride Resins:[2]				
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for—				
Film (resin content)		6,984,897		7,103,601
Sheeting (resin content)		4,429,090		3,969,696
Molding and extrusion (resin content)		14,452,489		14,832,342
Textile and paper treating and coating (resin content)[3]		5,240,024		5,035,689
Flooring (resin content)		5,108,558		4,317,783
Protective coatings (resin content)		2,448,552		2,138,727
All other uses (resin content)		4,583,793		4,402,650
All other vinyl resins for—				
Adhesives (resin content)		2,808,594		2,322,066
All other uses (resin content)		9,236,637		8,507,611
TOTAL	61,730,829	55,292,634	56,117,522	52,630,165
Coumarone-Indene and Petroleum Polymer Resins	22,503,247	21,007,363	20,993,056	21,357,009
Polyester Resins:				
For reinforced plastics	4,929,504	4,400,101	5,562,760	4,292,873
For all other uses	297,626	248,357	249,040	205,024
TOTAL	5,227,130	4,648,458	5,811,800	4,497,897
Polyethylene Resins	32,507,563	28,063,012	30,390,036	27,930,266
Miscellaneous Synthetic Plastics and Resin Materials:				
Molding materials[1] [4]	4,276,291	3,793,801	4,294,959	3,867,582
Protective-coating resins[5]	370,686	196,254	395,940	246,274
Resins for all other uses[6]	6,738,794	6,562,524	6,646,002	6,143,772
TOTAL	11,385,771	10,552,579	11,336,901	10,257,628
GRAND TOTALS	277,438,696	239,684,486	257,104,691	236,055,112

[1]Includes fillers, plasticizers, and extenders.
[2]Production statistics by uses are not representative, as end use may not be known at time of manufacture.
[3]Includes data for spreader and calendering-type resins.
[4]Includes data for acrylic, polyethylene, nylon, and other molding materials.
[5]Includes data for epichlorohydrin, acrylic, polyester, silicone, and other protective-coating resins.
[6]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

SOURCE: United States Tariff Commission, Chemical Division.

(Industrial News Briefs Cont'd. from page 566)

National Lead Co., New York, N. Y., through its subsidiary, Canadian Titanium Pigments, Ltd., will construct Canada's first titanium pigment plant near Varennes, Quebec, at a cost of about $15,000,000. The new plant is designed to meet Canada's entire requirements for titanium oxide, the company says. Production of titanium pigment is expected to begin in 1957. About 400 will be employed.

The B. F. Goodrich Chemical Co., Cleveland, O., reveals that bases made of its Geon vinyl plastic, filled with sponge rubber, are now in use by four major league baseball clubs. The bases, called Hollywood Star, have no straps or buckles to trip players, and are washable and weather-resistant.

Junior Achievement, Inc., New York, N. Y., presented the Seventh Plastics Products Award to Acco Plastics, Dallas, Tex., for its plastic match box holders and buffet dishes. Second prize went to Teen Resins Co., Springfield, Mass., and third prize to Home Plastics Co., Minneapolis, Minn.

Nacron Plastics, Inc., has been formed for the manufacture of acrylic sheets and button blanks. The plant is located at 140 Logan Ave., Jersey City, N. J.

Molded Products, a division of Admiral Corp., has announced a change of corporate name and address to Molded Products Division of Admiral Corp., Washington St. and Creamery Rd., West Chicago, Ill. They were previously located at 4533 West Harrison St., Chicago, Ill.

Minnesota Mining & Mfg. Co.'s Irvington Division, Irvington, N. J., has formed a new special products section for the development and sales of such non-electrical products as coated neoprene, silicones, oleoresinous materials, and vinyl. John W. Apgar has been made manager of the new section.

Brown-Allen Chemicals, Inc., Staten Island, N. Y., has appointed Masten-Wright Corp., P. O. Box 1896, New Haven, Conn., as its exclusive export manager. George N. Vitt will direct the operation.

Corrosion Chemical Co. of America, Los Angeles, Calif., has decided to withdraw from the formulation and sales of epoxy resins for adhesives, coatings, and tooling compounds.

Pittsburgh Coke & Chemical Co., Pittsburgh, Pa., has formed a chemical procurement department to service the requirements of its chemical divisions, with J. W. McNeil named manager and H. A. Carpenter named assistant manager of the new department.

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CALENDAR of COMING EVENTS

October 26
Reinforced Plastics Group, SPE New York Section, Tufaro's Restaurant, Corona, N. Y.

November 1
SPE Southern California Section, Scully's Restaurant, Los Angeles, Calif.

November 2
SPE Western New England Section, Bradley Field, Windsor Locks, Conn.

November 9
SPE Newark Section, Military Park Hotel, Newark, N. J.

November 14
SPE Cleveland-Akron Section, Spanish Tavern, Breckville, O.

November 14-15
TAPPI National Plastics Meeting, Brooklyn, N. Y.

November 14-16
ASTM, Committee D-20, Netherlands Plaza, Cincinnati, O.

November 16
SPE New York Section, One-day symposium, "Plastics for Packaging"

November 17
SPE Eastern New England Section, Hotel Beaconsfield, Brookline, Mass.

November 21
SPE Southern Section, Mammy's Shanty, Atlanta, Ga.

November 22
MCA 5th Semi-Annual Meeting, Statler Hotel, New York City

December 1
For Wayne Rubber & Plastics Group, Van Orman Hotel, Fort Wayne, Ind.

December 6
SPE Southern California Section Scully's Restaurant, Los Angeles, Calif.

December 6, 7
SPI Film, Sheeting, and Coated Fabrics Divisional Conference, Hotel Commodore, New York, N. Y

December 9
Detroit Rubber & Plastics Group Xmas Party

December 14
SPE New York Section, Xmas Party, Gotham Hotel, New York City

Current Market Prices

This listing is as comprehensive and up-to-date as possible. The full listing will appear quarterly, while intervening issues will carry a briefer tabulation of price changes and additions.

Companies whose products do not appear are invited to submit price data for inclusion in the listing. All suppliers are requested to submit product additions and price changes promptly as they occur, in order to make this listing of maximum value to our readers.

Prices, in general, are f.o.b. works. Ranges indicate quantity or grade variations. No guarantee of these prices is made, and spot prices should be obtained from the individual suppliers.

—The Editor

Adhesives

Ampcoflex Adhesive	gl.	$2.75 /	$3.50
Bakelite BC—17613	lb.	.54	.84
BCU-40	lb.	.18	.48
BR-11938	lb.	.285	.585
Bonding resins, abrasives	lb.	.20 /	.915
Brake linings	lb.	.215	.6275
Foundry resins	lb.	.2075	.395
Heat Insul. resins	lb.	.1425	.37
CD Cement Nos. 200, 201, 202, 203, 204	gl.	$0.94 /	$1.50
PS-7	gl.	2.12 /	2.90
Epoxy Adhesive A-1, A-3			
A-4	gl.	4.45 /	6.90
A-2, A-3	gl.	5.60 /	8.00
A-6	gl.	5.80 /	8.00
C-1, C-2, C-3, C-9	gl.	5.60 /	8.00
C-4, C-7	gl.	3.69 /	5.30
Flexible Resin No. 1	gl.	4.45 /	6.90
G-E 12316	lb.	.2975/	.3975
Melmac 401	lb.	.45	
421	lb.	.45 /	.47
Melurac 300, 302	lb.	.25 /	.29
301	lb.	.28 /	.33
Meilbond 2002-14	gl.	1.84 /	5.00
4021 Type I	sq. ft.	1.43	
Type II	gl.	1.29 /	3.20
Type III	gl.	1.49 /	3.50
Plaskon Phenolic Bonding Resin	lb.	.16 /	.21
Urea Adhesive 530-11L	lb.	.1875/	.2175
Liquid Adhesive, 2L Types	lb.	.105 /	.115
WR Types	lb.	.0675/	.125
Spray Dried Adhesives	lb.	.18 /	.29
Plastic Cement	gal.	2.25 /	2.70
Polyester Foam Cement PC-232	gal.	2.40 /	2.90
Schenectady SP-7401	lb.	.29 /	.31
Schwartz Vinyl Cement	qt.	1.24 /	1.50
Styrofoam Adhesive #5	gal.	3.75 /	4.75
Thixons	gal.	3.30 /	9.00
Urac 110	lb.	.205 /	.225
115	lb.	.24 /	.26
180	lb.	.095 /	.12
185	lb.	.1625/	.2175
186	lb.	.0875/	.1125
192	lb.	.07	

Anti-Static Agents

Anstac-2M	gl.	1.75 /	2.00
Logostat	gal.	1.35 /	1.65
Merix Anti-Static	qt.	1.60 /	4.00
Stabilite	lb.	.355 /	1.75

Catalysts

Advasol	lb.	.4375/	.5375
Aritemp Curing Agent 105	lb.	2.00 /	2.25
Bakelite BH-17618	lb.	.33 /	.63
BHU-53	lb.	.15 /	.45
ERL series	lb.	.67 /	1.195
Cadet benzoyl peroxide, granules	lb.	.98 /	2.00
Paste	lb.	.95 /	2.25
Powder	lb.	1.50 /	2.37
Dichlorobenzoyl peroxide	lb.	3.00 /	4.25
Lauroyl peroxide	lb.	1.90 /	3.50
Methyl ethyl ketone peroxide	lb.	1.85 /	4.00
Catalyst 57	lb.	.12	
196	lb.	.10	
C-110, -180, -180-S, C-110-S, WF-100, -101	lb.	.12	
Curing Agent A	lb.	3.00 /	6.75
B	lb.	3.00 /	4.75
Furane H-736-A	lb.	1.30 /	2.00
Hardener 157	lb.	1.00 /	1.15
175, 179, 191	lb.	.50 /	.65
181, 184, 185, 185-S, M-325	lb.	.12	
342	lb.	1.40 /	1.55
H C Promoter 6%	lb.	.5275/	.6275
12%	lb.	.9025/	1.0025
HN 551	lb.	.95 /	1.40
901	lb.	.36 /	.80
951 Ciba	lb.	.82 /	1.32
951 Furane	lb.	1.30 /	2.00
IC activators		3.00	
Inhibitor	lb.	.98	
Melurac 255, 259	lb.	.35	
Modifier CB-110,WF-61	lb.	.15	
Plaskon Hardeners, Liquid	lb.	.07	
Powdered	lb.	.10 /	.46
Spray dried	lb.	.10 /	.25
Promoter D-2	lb.	1.60 /	2.00
SA Hardener	lb.	.10	
Shell ditertiary butyl peroxide	lb.	1.965 /	2.92
Soligen	lb.	.4825/	.5825

Coating Resins

Bakelite Phenolics	lb.	.28 /	.64
Styrene emulsions	lb.	.1375/	.31
Vinyl acetates	lb.	.295 /	.66
Solutions	gal.	5.10	
Alcohols	gal.	2.27 /	2.76
Butyral resins	lb.	1.04 /	1.24
Chlorides	lb.	.41 /	.61
Chloride-acetates	lb.	.38 /	.66
Modified	lb.	.44 /	.72
CD Strip A	gl.	1.13 /	2.10
Dylex K-500, -600, -700, -900	lb.	.30 /	.46
G.M.I. Polyamide 100	lb.	.51 /	.64
115	lb.	.54 /	.77
Kel-F Dispersion (dry wt.)	lb.	12.00	
Plaskon Alkyds	lb.	.1075/	.3375
Modified	lb.	.15 /	.2625
Ester Gums	lb.	.1425/	.2475
Maleics	lb.	.1825/	.275
Melamines	lb.	.195 /	.435
Phenolics	lb.	.3925/	.475
Modified	lb.	.1825/	.29
Phenolic Laminating Varnishes	lb.	.165 /	.27
Silicone Alkyds	lb.	1.10 /	2.40
Ureas	lb.	.195 /	.435
Polyfluoron liquid dispersions	lb.	2.65 /	3.85
Paste dispersions	lb.	4.20 /	4.40
Primer 140	gl.	7.88 /	8.25
Schenectady Alkyds SA Type	lb.	.3575/	.38
SE Type	lb.	.3675/	1.435
SEA Type	lb.	.3575/	.38
Styrenated	lb.	.22 /	.2625
Maleics	lb.	.1725/	.23
Phenolics	lb.	.2325/	.53
Modified	lb.	.1825/	.275
Schwartz AT-25	gl.	.63 /	1.00
BE-40	gal.	3.80 /	3.95
Synvaren 631	lb.	.17 /	.25
Synvarite BRLD	lb.	.39 /	.45

Colors

Acheson 0100 Series Paste

Dispersions			
Blacks	lb.	.50 /	.81
Blues	lb.	.55 /	2.175
Green	lb.	2.31 /	2.69
Orange	lb.	.67 /	.85
Reds	lb.	1.08 /	1.34
White	lb.	.52 /	.70
Yellows	lb.	.57 /	.75
Advacrite M-10	lb.	2.25 /	2.40
Advance Brightener M.D.A.C.	lb.	12.00 /	15.00
Aquablaks	lb.	.085 /	.235
Cabot carbon blacks	lb.	.05 /	.79
Cadmolith Reds	lb.	1.72 /	2.20
Yellows	lb.	1.12 /	1.20
Claremont 4000-series Pastes			
Blacks	lb.	.82 /	1.01
Blue	lb.	.80	
Browns	lb.	.65 /	2.30
Greens	lb.	.80 /	2.15
Orange	lb.	1.58	
Red	lb.	4.15 /	4.80
Silver	lb.	1.02	
White	lb.	.695	
Yellows	lb.	.65 /	2.87
D-Series pastes.			
Blacks	lb.	.47 /	.68
Blues	lb.	.62 /	1.55
Golds	lb.	2.31 /	2.49
Green	lb.	1.86 /	1.88
Oranges	lb.	.70 /	3.65
Reds	lb.	1.10 /	2.57
Silver	lb.	.89 /	.91
Whites	lb.	.45 /	.60
Yellows	lb.	.55 /	1.68
K-Series pastes.			
Blacks	lb.	.58 /	.71
Blues	lb.	.91 /	1.40
Browns	lb.	.53	
Greens	lb.	.94 /	1.41
Metallics	lb.	.91 /	2.47
Orange	lb.	.80 /	3.84
Reds	lb.	1.03 /	5.07
Violet	lb.	2.30	
Whites	lb.	.59 /	.60
Yellows	lb.	.73 /	3.02
Codispersions	lb.	.23 /	.24
Covinylblaks	lb.	.68 /	1.145
Cowaxblaks	lb.	.4075/	.6075
Cyanamid dyes, calcozines	lb.	.81 /	5.57
Nigrosines and Indulines	lb.	.59 /	.97
Oils	lb.	.62 /	7.29
Inorganic pigments			
Blues, cobalt	lb.	.305 /	.35
Iron	lb.	.51 /	
Ultramarine	lb.	.165 /	.325
Greens, chrome	lb.	.40 /	.45
Oranges, chrome	lb.	.335	
Molybdate	lb.	.465	
Yellows, chrome	lb.	.335	
Zinc	lb.	.275	
Organic pigments			
Blues, alkali, dry	lb.	2.10	
Flushed	lb.	1.20	
Molybdated & tungstated	lb.	2.60 /	6.10
Phthalocyanine	lb.	.90 /	3.60
Greens, mol. & tung.	lb.	3.20 /	6.20
Phthalocyanine	lb.	1.71 /	3.95
Oranges	lb.	.70 /	3.00
Reds, bon	lb.	1.50 /	2.00
Chlorinated	lb.	1.20	
Lithols	lb.	.85 /	.90
Naphthols	lb.	.80 /	3.60
Paras	lb.	1.05	
Rhodamines	lb.	4.25 /	6.15
Toluidines	lb.	1.60	
Yellows	lb.	.56 /	2.25
Ferro blues, browns, greens	lb.	.90 /	2.96
Reds	lb.	2.93 /	4.75
Yellows	lb.	.91 /	2.90
Harwick, blues	lb.	1.55 /	4.55
Brown	lb.	3.00	
Greens	lb.	1.55 /	4.50
Oranges	lb.	1.05 /	1.25
Reds	lb.	1.20 /	3.53
Yellows	lb.	.85 /	4.50
Interchemical 1C Series			
Black	lb.	.56	
Blues	lb.	.75 /	2.10
Browns	lb.	.64 /	.69
Greens	lb.	.90 /	.99
Oranges	lb.	.78 /	.89
Reds	lb.	1.16 /	2.50
White	lb.	.70	
Yellows	lb.	.95 /	1.65
IVO bone blacks	lb.	.16 /	.2175
Kentucky inorganics, orange	lb.	.44 /	.64
Yellows	lb.	.31 /	.66
Organics, blues	lb.	3.00 /	4.15
Greens	lb.	3.50 /	4.60
Purple	lb.	1.85 /	2.05
Reds	lb.	1.95 /	3.85
Kriegr-O-Dip W Types	qt.	2.63 /	7.80
A Types	qt.	1.52 /	2.25
Laminac color pastes	lb.	.76 /	1.90
Mapico blacks	lb.	.135	
Browns	lb.	.145	
Tans	lb.	.21	
Yellows	lb.	.1125/	.1175

Mearlmaid Pearls	lb.	14.00 /	25.00
Nacromer Pearls, Series C	lb.	2.15 /	2.25
Series W	lb.	1.50 /	1.60
Plastic Color, blacks	unit	.75 /	1.40
Blues	unit	.65 /	1.10
Brown	unit	1.20	
Greens	unit	.65 /	1.00
Reds	unit	.65 /	2.50
Whites	unit	.80 /	1.30
Yellows	unit	1.15 /	1.55
PMS polyester colors	lb.	.85 /	2.85
Polystyrene colors	lb.	.65 /	4.30
Polysupra polyethylene blues	lb.	.65 /	5.60
Blacks	lb.	.50 /	.80
Browns	lb.	1.48 /	3.30
Greens	lb.	1.82 /	3.55
Ivory	lb.	.65 /	1.00
Purples	lb.	2.10 /	3.30
Reds	lb.	.70 /	6.30
Silver	lb.	1.50 /	2.95
White	lb.	.60 /	.85
Yellow	lb.	1.45 /	4.25
Polystyrene blues	lb.	.50 /	9.20
Blacks	lb.	.50 /	5.30
Browns	lb.	.95 /	2.55
Greens	lb.	.35 /	7.40
Ivory	lb.	.85 /	1.20
Reds	lb.	.35 /	6.40
White	lb.	.60 /	1.05
Yellows	lb.	1.45 /	2.95
R-C blacks	lb.	5.50 /	21.30
Browns	lb.	4.375 /	15.75
Reds	lb.	.28 /	15.05
Yellows	lb.	3.60 /	14.05
Rez-N-Dye (dry wt.)	lb.	7.50	
Saran colors	lb.	.59 /	1.80
Sherwin-Williams Dispersed Colors	lb.	.55 /	1.97
Inorganic colors, oranges, yellows	lb.	.32 /	.45
Organic colors, blues	lb.	.90 /	3.60
Greens	lb.	1.35 /	3.95
Reds	lb.	.85 /	4.40
Yellows	lb.	.55 /	1.97
Vansul Organic Drys			
Blues	lb.	3.45 /	3.60
Greens	lb.	1.35 /	3.95
Oranges	lb.	2.21 /	3.00
Reds	lb.	.90 /	4.40
Yellows	lb.	2.00 /	2.25
VAP Dry Dispersions			
Black	lb.	1.00	
Blues	lb.	2.90 /	3.60
Greens	lb.	3.20 /	4.05
Oranges	lb.	1.45 /	2.55
Reds	lb.	1.70 /	4.45
Yellows	lb.	1.35 /	2.55
VP-Series Pastes			
Black	lb.	.70	
Blue	lb.	1.65	
Brown	lb.	1.55	
Green	lb.	2.05	
Oranges	lb.	.80 /	2.30
Reds	lb.	1.15 /	2.55
White	lb.	.47 /	.65
Yellows	lb.	.60 /	1.65
VPE-Series Pastes			
Black	lb.	.90	
Blue	lb.	1.85	
Green	lb.	2.10	
Orange	lb.	1.00	
Reds	lb.	1.45 /	2.30
White	lb.	.90	
Yellows	lb.	1.60 /	2.00
VV Chips			
Blacks	lb.	.90 /	1.30
Blues	lb.	1.00 /	2.25
Brown	lb.	1.60	
Greens	lb.	.90 /	2.45
Oranges	lb.	1.00 /	2.15
Reds	lb.	1.40 /	2.70
White	lb.	.65	
Yellows	lb.	.85 /	1.80
Vinylized colors, blacks, whites	lb.	.755	
Blues	lb.	1.16 /	1.18
Golds	lb.	1.51 /	1.57
Green	lb.	1.45	
Metallic	lb.	1.15	
Orange	lb.	.83	
Reds	lb.	1.15 /	2.27
Yellows	lb.	.76 /	1.09
Violite 199, green	lb.	2.95	
200, yellow	lb.	3.75	
PL 3-60, blue	lb.	3.25	
18-70, blue	lb.	3.70	
Witcoblaks	lb.	.075 /	.37
Zopaque, anatase	lb.	.225 /	.235
Rutile	lb.	.245 /	.255

Dispersing Agents

Daxads	lb.	.08 /	.40

Fillers

Cab-o-sil	lb.	.68 /	.75
Calcene NC	lb.	.036 /	.059
TM	lb.	.0375/	.0625
Camel—CARB	ton	12.00	
—TEX	ton	20.00	
—WITE	ton	32.50	
Cotton flocks	lb.	.12 /	.32
Dixie Clay	ton	14.00 /	34.50
Edgar ASP 200	ton	43.00	
900	ton	18.50	
1300	ton	80.00	
Harwick clays	ton	14.00 /	57.00
Flock	lb.	.11 /	.28
Magnesia	lb.	.105 /	.13
Mica	lb.	.075 /	.0825
Pecan Shell Flour	ton	80.00 /	100.00
Stan White 325	ton	8.50 /	11.00
Walnut Shell Flour	ton	55.00 /	100.00
Hi-Sil 101	lb.	.10 /	.155
233	lb.	.09 /	.105
Hydrite	ton	22.50	
Flat	ton	22.50	
PD-10	ton	46.50	
Kalite	ton	50.00 /	65.00
McMamee Clay	ton	13.50 /	33.00
Multifex MM	ton	110.00 /	125.00
Nytal 200L	ton	27.00 /	50.00
300	ton	37.00 /	60.00
Silene EF	lb.	.06 /	.105
Surfex MM	ton	37.00 /	52.00
Suspenso	ton	33.00 /	48.00
Witcarb P	ton	110.00 /	140.00
R	ton	120.00 /	150.00
Regular	ton	56.75 /	85.00
Wollastonite F-1	ton	23.00 /	25.00
P-1	ton	25.00 /	27.00

Finishes

Toy Gloss T-11 H	gal.	2.75 /	4.45
Logoquant colors	gal.	3.35 /	11.95
Silk screens	gal.	1.50 /	6.11
Logoset Series W	gal.	1.72 /	7.64

Flame-Proofing Agents

IC-776 Antimony Concentrate	lb.	.495 /	.51
M&T Antimony Oxide	lb.	.27 /	.285
Flame Retarder	lb.	.29 /	.305

Lubricants

Baselube	qt.	2.50 /	4.00
Bomb-Lube	can	1.75 /	2.50
DC-36 Emulsion	lb.	1.36 /	2.50
Garalease 915	gal.	3.80 /	4.50
HSC 435	lb.	1.36 /	1.48
IC-500	gal.	2.50	
-571	gal.	3.25	
-793-10	gal.	3.40	
Lunn-Lease	gal.	4.15 /	4.85
M-1 Mold Release	lb.	3.00 /	4.00
Metasap barium stearate	lb.	.37 /	.42
Calcium 627	lb.	.36 /	.41
Stearate	lb.	.35 /	.40
Magnesium stearate	lb.	.38 /	.43
Mold-Ease Concentrate PCR	qt.	2.50 /	5.85
Mold Release 225	gal.	5.25 /	6.00
235	gal.	6.00	
Mold-Wiz	gal.	4.00 /	6.00
Part-A-Part	gal.	3.05 /	3.75
Partingkote No. 823	qt.	1.18 /	4.36
Prepoxy No. 832 A	qt.	2.85 /	3.00
Plastik Parting Fluid No. 829	qt.	2.18	
Releasor Wax No. 826	lb.	2.29	
Sprits	lb.	1.00 /	1.25
SS-452	gal.	2.80 /	4.90
Toplube	qt.	2.50 /	4.00
Vibrin-VPA Parting Agent	gal.	4.25 /	4.65

Miscellaneous

Advaresin C X F	lb.	.49 /	.55
K F	lb.	.40 /	.46
Dutch Boy Bentone	lb.	.44 /	.60
Ben-A-Gel	lb.	.98 /	1.40
Metasap Water Proofing Agent 569	lb.	.21	
PMS Purging Compound	lb.	.35	

Molding Compounds & Resins

Acrylic

Cadco cast rods	lb.	1.42 /	6.96
Polished	lb.	1.58 /	7.16
Machined rods	ft.	22.00 /	89.54
Tubes	lb.	1.39 /	5.76
Polished	lb.	1.51 /	5.99
Colors	lb.	1.62 /	5.99
Pearl	lb.	1.99 /	6.76
Lucite injection molding powders:			
Colorless, transparent	lb.	.68 /	.80
Std. colors	lb.	.72 /	1.00
Compression molding powders	lb.	.65 /	.75
Plexiglas molding powders:			
Colorless	lb.	.65 /	.835
Colors, stock	lb.	.69 /	.883
Custom	lb.	.69 /	1.035
Sheets, Types I-A & II			
Colorless	sq. ft.	.20 /	23.88
Colored	sq. ft.	.88 /	1.82
Type R: colorless	sq. ft.	.60 /	1.04
Colored	sq. ft.	.87 /	1.33
Polycast 1	sq. ft.	.80 /	2.40

Alkyd

Plaskon foundry resin 580-11L	lb.	.245 /	.275
Molding compound, Type 411	lb.	.43 /	.60
Type 413, 417	lb.	.57 /	.74
Type 420 black	lb.	.44 /	.695
Type 422 colored	lb.	.51 /	.695
Mottle	lb.	.52 /	.705
Natural	lb.	.49 /	.60
Type 430	lb.	.34 /	.50

Cellulosic

Cellulose acetate:			
Ampacet Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III			
Colors	lb.	.50 /	.59
Metallic	lb.	.63 /	.71
Pearl	lb.	.59 /	.68
Phosphorescent	lb.	.80 /	.89
Celanese film rolls			
Clear	lb.	.64 /	.87
Colors	lb.	.88 /	1.74
Sheets			
Clear	M. sq. in.	.032 /	.107
Colors	M. sq. in.	.042 /	.141
Lumarith molding cmpds.,			
Group I	lb.	.50 /	.59
Group II	lb.	.46 /	.55
Group III	lb.	.36 /	.43
Sheeting, extruded, non-stock			
Clear	lb.	.12 /	1.89
Colors	lb.	.15 /	2.07
Stock, clear	M. sq. in.	.12 /	1.62
Colors	M. sq. in.	.14 /	1.61
Cast, rolls			
Clear	M. sq. in.	.125 /	.558
Matte	M. sq. in.	.179 /	.648
Tinted	M. sq. in.	.239 /	.708
Sheets, clear	M. sq. in.	.141 /	1.52
Matte	M. sq. in.	.203 /	.788
Tinted	M. sq. in.	.255 /	1.72
Hercocel A, extrusion & injection	lb.	.50 /	.65
Injection, std. colors	lb.	.46 /	.61
Special colors	lb.	.42 /	.45
Tenite Acetate, Group 1	lb.	.50 /	.59
Group 2	lb.	.46 /	.55
Group 3	lb.	.41 /	.51
Group 4	lb.	.38 /	.49
Group 5	lb.	.65 /	.75
Cellulose acetate butyrate:			
Tenite butyrate	lb.	.62 /	.71
A pearls	lb.	.72 /	.81
Blacks, reprocessed	lb.	.50 /	.58
Ethyl cellulose:			
Dyeform 720, 721	lb.	1.29 /	1.52
Ethocel P. G.	lb.	.72 /	.80
Bulk, reg.	lb.	.66 /	.81
Std., 7 cps.	lb.	.71 /	.86
Hercocel E	lb.	.72 /	.88

Epoxy

Araldite 502, 6010 6020	lb.	.80 /	.995
504	lb.	.77 /	.965
551, 6060	lb.	.75 /	.95
6030, 6040	lb.	.885 /	.995
Bakelite ERL series	lb.	.80 /	.995
Epocast 2, 3, 5	lb.	1.33 /	1.77
4-B-2, 4-B, 4-C, 4-C-T, 4-D, Paste	lb.	1.15 /	1.55
Epon 828	lb.	.80 /	1.21
834	lb.	.90 /	1.56
864	lb.	.91 /	1.44
864-C-75	lb.	.73 /	.74
1001	lb.	.615 /	1.56
Furane CN-502	lb.	1.33 /	1.77
Jet-Kote (with cat.)	gal.	7.50 /	10.00
Rezolin L-900	lb.	1.33 /	2.19
L-910	lb.	1.42 /	2.19
L-930	lb.	1.51 /	2.19
L-940, -941, -942	lb.	1.52 /	2.19

Fluorocarbon

Bakelite FGBB-33789, FGEB-34790, FXMA-50590, FXMB-50344	lb.	9.00 /	10.00
FGEB-32788, FXMB-50090	lb.	12.00 /	14.00

FVTD	lb.	11.00 /	13.00
FVTH, FYTS	lb.	8.50 /	9.50
Kel-F Grade 270, 300			
High density	lb.	9.00 /	10.00
Low density	lb.	8.50 /	9.50
Grade 300-P25	lb.	10.00 /	11.00
Polyfluoron, high density crystals & pellets	lb.	9.00 /	9.50
Colors	lb.	9.50 /	10.00
Low density powder	lb.	8.50 /	9.00
Dispersion grade	lb.	10.50 /	11.00
Teflon powder, dispersion	lb.	7.00 /	7.75
Fine	lb.	9.50 /	11.00
General	lb.	5.10 /	5.75
Tape cylinder	lb.	5.35 /	6.00

Melamine

Fiberite 2016	lb.	.95	
Melmac 402	lb.	.51 /	.53
404R 404T	lb.	.85 /	.95
405	lb.	.45 /	.52
428	lb.	.48 /	.55
430	lb.	.465 /	.535
440	lb.	1.10	
480	lb.	.265 /	.315
1077, 1079	lb.	.47 /	.75
1500	lb.	.42 /	.55
1502	lb.	.45 /	.58
3020	lb.	.57 /	.72
3024-A	lb.	.67	
3135	lb.	.90 /	1.10
P-592, -592-A	lb.	.65 /	.75
Plaskon	lb.	.44 /	.75

Phenolic

91-LD	lb.	1.50 /	2.50
Admirez PL-50	lb.	.215	
UP-11	lb.	.2325	
Bakelite general purpose	lb.	.187 /	.3525
BMG-5000	lb.	.19 /	.30
Colors	lb.	.2375/	.435
Chem. resist	lb.	.23 /	.40
Electrical Insul	lb.	.2725/	.4125
Heat resist	lb.	.19 /	.35
Impact resist	lb.	.24 /	.4025
Barrett foundry resins, liquid	lb.	.2125/	.2425
Powdered	lb.	.27 /	.355
Insulation resins	lb.	.15 /	.175
Molding resin 313, 314, 317	lb.	.27 /	.285
316	lb.	.295 /	.31
1502, -3, -4, -5, R-110R	lb.	.25 /	.265
R-114	lb.	.285 /	.30
Corfoam 107, 114	lb.	.55 /	.82
Cyncor 151	lb.	.215 /	.235
191	lb.	.13 /	.16
Durez, heat resist	lb.	.19 /	.245
Impact resist	lb.	.24 /	.63
Insulation	lb.	.21 /	.305
Non-Bleed	lb.	.19 /	.195
Special	lb.	.19 /	.665
Std	lb.	.19 /	.245
Durite GP	lb.	.195 /	.24
HR	lb.	.191 /	.3025
IM	lb.	.24 /	.415
SG	lb.	.195 /	.3575
Fiberite 1078	lb.	.42 /	.43
1087, 1165, 1270, 1271, 1330, 1332, 1347, FM 1132, FM 3510	lb.	.39 /	.395
1153	lb.	.453 /	.46
1167	lb.	.3875/	.3925
1340	lb.	.4275/	.4325
1346	lb.	.44 /	.4475
4010	lb.	.68	
4020	lb.	.815 /	.82
FM 926	lb.	.43 /	.435
927	lb.	.41 /	.415
1914	lb.	.375 /	.38
1957	lb.	.445 /	.45
1996	lb.	.375 /	.38
10365	lb.	.5225/	.5275
11547	lb.	1.05 /	1.06
11678	lb.	.52 /	.525
14111	lb.	.415 /	.42
17067	lb.	.851 /	.82
17610	lb.	1.05 /	1.06
G-E 12316 foundry resin	lb.	.2975/	.3975
12368, 12374, 12392 shell mold	lb.	.26 /	.36
12408, 12460, 12490, 12491, 12493, 12853, 12863, 12875			
12460	lb.	.19 /	.20
12420, 12439	lb.	1.05 /	1.15
12430, 12817, 128882	lb.	.20 /	.21
12432	lb.	.39 /	.395
12433	lb.	.55 /	.555
12435	lb.	.235 /	.24
12439, 12466	lb.	.26 /	.36
12444	lb.	.42 /	.425
12462	lb.	.50 /	.505
12463	lb.	.40 /	.405
12467	lb.	.50 /	.60
12486	lb.	.195 /	.20
12487, 12489 rubber-phenolic	lb.	.355 /	.36
12494 rubber-phenolic	lb.	.375 /	.38
12495	lb.	.24 /	.245
12808 rubber-phenolic	lb.	.49 /	.495
12809 rubber-phenolic	lb.	.65 /	.655
12824	lb.	.49 /	.495
12841	lb.	.2375/	.2425
Loven LHR-401, -403	lb.	.225 /	.23
-407, -409	lb.	.60 /	1.00
-408	lb.	.25 /	.255
LI201	lb.	.39 /	.40
-207	lb.	.475 /	.48
-209	lb.	.60 /	1.00
-212	lb.	.425 /	.43
LM-110, -119	lb.	.19 /	.195
-101	lb.	.24 /	.245
-116	lb.	.255 /	.26
-117	lb.	.225 /	.23
-118	lb.	.1975/	.2025
LMI-301	lb.	.2525/	.2575
-303	lb.	.345 /	.35
-304	lb.	.60 /	1.00
-307	lb.	.3075/	.3125
LMM-801, -803	lb.	.2125/	.2175
-804, -811	lb.	.245 /	.25
-807	lb.	.215 /	.22
Marblette casting resins	lb.	.50 /	.60
Plenco foundry resins	lb.	.27 /	.35
Molding cmpds. gen. purpose	lb.	.185 /	.235
Heat resist	lb.	.19 /	.24
Improved impact	lb.	.225 /	.28
Min. bleed	lb.	.185 /	.195
Radio & TV	lb.	.20 /	.215
Stock	lb.	.205 /	.34
Reilly general purpose	lb.	.195 /	.20
Heat & impact resist	lb.	.20 /	.205
Resinox, gen. purpose, heat resist	lb.	.19 /	.20
Impact	lb.	.245 /	.3125
Low elec. loss	lb.	.30 /	.355
Special	lb.	.20 /	.24
Rogers RX-425	lb.	.285 /	.35
-428	lb.	.345 /	.42
-429	lb.	.355 /	.425
-431	lb.	.4125/	.495
-438	lb.	.4575/	.4625
-442	lb.	.3375/	.3425
-447	lb.	.495 /	.50
-448	lb.	.345 /	.35
-458	lb.	.37 /	.375
-469	lb.	.355 /	.36
-525	lb.	.285 /	.29
-530	lb.	.4125/	.4175
-625	lb.	.385 /	.39
Schenectady shell mold resins	lb.	.26 /	.28
Toolplastik No. 8000	lb.	.48 /	.72

Polyamide

G.M.I. Polyamide 115	lb.	.64 /	.77
Zytel molding powder	lb.	1.435 /	1.60

Polyester

Atlac 363E-02Z, -12Z	lb.	.66 /	.69
-32Z	lb.	.68 /	.71
382E	lb.	.57 /	.60
FP	lb.	.66 /	.69
Bakelite Polyester resins	lb.	.35 /	.75
Diall 50-01, -51	lb.	3.00 /	3.50
51-01	lb.	.76 /	.90
52-01	lb.	1.88 /	2.50
52-20-30	lb.	1.30	
Hetron	lb.	.43 /	.485
IC-312, -400, -514, -548, -625, -730, -800	lb.	.35 /	.385
-312-2	lb.	.365 /	.38
-336, -382, -706	lb.	.37 /	.385
-401	lb.	.44 /	.455
-420	lb.	.355 /	.37
-433	lb.	.38 /	.395
-636, -670	lb.	.48 /	.495
-638, -689	lb.	.55 /	.565
-670-2	lb.	.50 /	.515
-671	lb.	.405 /	.42
Filled resins	lb.	.255 /	.54
Laminac 4110	lb.	.33 /	.345
4111	lb.	.45 /	.465
4116	lb.	.33 /	.345
4120	lb.	.39 /	.405
4123, 4128	lb.	.34 /	.355
4134	lb.	.46 /	.475
4146	lb.	.43 /	.445
4192	lb.	.355 /	.37
4202	lb.	.55 /	.565
Mylar, rolls, types A & C	lb.	2.80 /	4.80
Type D	lb.	3.00 /	3.30
Sheets, type A	M sq. in.	.09 /	1.11
Type C	M sq. in.	.09 /	.15
Type D	M sq. in.	.53 /	1.34
Plaskon 911, 920	lb.	.55 /	.665
941, 942, 951, 9411	lb.	.35 /	.465
943	lb.	.41 /	.525
9404	lb.	.365 /	.48
9406	lb.	.355 /	.465
9500, 9510, 9511	lb.	.35 /	.465
9600	lb.	.44 /	.555
Polycast 2	sq. ft.	1.89 /	5.18
3	sq. ft.	1.08 /	18.00
6	sq. ft.	.66 /	3.10
7	sq. ft.	.72 /	7.18
CR-39	sq. ft.	1.25 /	20.00
Pre-Imp	lb.	.68 /	.85
Thermaflow 100T	lb.	.62 /	1.05
120	lb.	.89 /	1.25
200T, 300T	lb.	.62 /	1.05
400T, 500T	lb.	.70 /	1.10
Vibrin No. 112	lb.	.40 /	.515
114, 117, 118, 131, 152	lb.	.35 /	.465
115A	lb.	.38 /	.495
121	lb.	.46 /	.575
135	lb.	3.00	
142	lb.	.55 /	.665
152	lb.	.365 /	.48
X-1029	lb.	.35 /	.465
X-1055B	lb.	.62 /	.73
X-1633A	lb.	.49 /	.605
X-1636W	lb.	.585 /	.70

Polyethylene

A-C No. 6, 617	lb.	.30 /	.37
No. 6A, 7, 617A	lb.	.35 /	.42
No. 615, G-201	lb.	.38 /	.45
No. 629	lb.	.40 /	.47
No. 729	lb.	.45 /	.52
Alathon	lb.	.41 /	.505
Bakelite DE Series	lb.	.43 /	.725
DYGT	lb.	.54 /	.69
DYLT, DYNF, DYNH	lb.	.41 /	.59
DYNJ	lb.	.44 /	.62
DYNK	lb.	.45 /	.63
Celanese film, rolls	lb.	.61	
Sheets	M sq. in.	.033 /	.257
Sheeting, rolls	lb.	.85 /	.98
Sheets	lb.	.98 /	1.15
Petrothene 100	lb.	.43 /	.47
200	lb.	.41 /	.45
Poly-Eth 1003	lb.	.44 /	.58
1004, 1005, 1007, 1008.5	lb.	.41 /	.55
3015, 5015	lb.	.35 /	.49
Reynolon 1000, P series	lb.	.60 /	.80
Tenite Group 1	lb.	.41 /	.45
Group 2	lb.	.43 /	.47
Group 3	lb.	.46 /	.50
Group 4	lb.	.39 /	.43
Group 5, 6	lb.	.50 /	.72
Group 7	lb.	.60 /	.82
Group 8	lb.	.70 /	.92

Silicone

Bakelite GMGA-5001, -5002	lb.	2.75 /	3.10
5003	lb.	4.00 /	4.35
5004	lb.	5.40 /	5.75

Styrenes

Ampacet, crystal	lb.	.315 /	.335
Colors, std	lb.	.345 /	.365
Special	lb.	.345 /	.75
Pearl	lb.	.41 /	.75
Phosphorescent	lb.	.695 /	1.00
Tinsel	lb.	.41 /	.67
Confetti	lb.	.51 /	.70
Bakelite BMC series, nat	lb.	.45 /	.685
Colors	lb.	.50 /	.735
BMS, SMD series, crystal	lb.	.295 /	.31
Colors, std	lb.	.335 /	.35
Special	lb.	.335 /	.52
RMD series, nat	lb.	.45 /	.685
Colors	lb.	.50 /	.735
TGD series	lb.	.33 /	.35
Colors, std	lb.	.36 /	.38
Special	lb.	.36 /	1.00
TMD series	lb.	.33 /	.40
Colors, std	lb.	.36 /	.43
Special	lb.	.36 /	1.00
Catalin, high impact, natural	lb.	.325 /	.355
Colors, std	lb.	.355 /	.385
Special	lb.	.36 /	1.00
Medium impact, natural	lb.	.325 /	.355
Colors, std	lb.	.355 /	.385
Special	lb.	.355 /	1.00
Regular grade, crystal	lb.	.305 /	.325
Colors, std	lb.	.345 /	.365
Special	lb.	.345 /	1.00
Utility black	lb.	.18 /	.235
Cycolac 12769 A, 12877, 12968, 12982	lb.	.73 /	.81
12803	lb.	.65 /	.73
12830, 12967	lb.	.70 /	.78
12876 A	lb.	.69 /	.77
12981	lb.	.78 /	.86
12983	lb.	.76 /	.84
12984	lb.	.77 /	.85
13022	lb.	.72 /	.80
Natural Powder	lb.	.58 /	.66
Pellets nat. & std. colors	lb.	.65 /	.73
Darex Copolymer 3	lb.	.47 /	.67
43G, X34	lb.	.42 /	.61
Latices 3L, 34L, 616L	lb.	.335 /	.48
610L	lb.	.30 /	.46
Dow Latex, polystyrene	lb.	.30 /	.46
Latices, styrene/butadiene	lb.	.30 /	.46
Dylite, expandable beads	lb.	.50 /	.60
Koppers, Fibertuff	lb.	.55 /	1.505
MC-185 series	lb.	.33 /	.355
-300 series	lb.	.33 /	1.005
-400 series	lb.	.355 /	1.005
Regular, crystal	lb.	.295 /	.315
Colors, std	lb.	.335 /	.355
Special	lb.	.335 /	1.005
Pearl	lb.	.41 /	1.005
Phosphorescent	lb.	.695 /	2.005
Krulastic, std. colors	lb.	.50 /	1.10
Lustrex HI-Flow 55, crystals	lb.	.295 /	.31
HI-Test 88, std	lb.	.36 /	.38
Special colors	lb.	.36 /	1.00
L, crystals	lb.	.295 /	.31
Colors, std	lb.	.335 /	.35
Special	lb.	.335 /	1.00
LHA, std	lb.	.355 /	.375
Special	lb.	.355 /	1.00
Utility black, gen. purpose	lb.	.18 /	.183

High impact	lb.	.235 /	.24
Medium impact	lb.	.19 /	.195
Marbon resins	lb.	.39 /	.46
Plio-Tuf G75C, G85C	lb.	.52 /	.55
Polycast 4	sq. ft.	2.56 /	11.07
Styron 475, natural	lb.	.33 /	.35
Colors, std.	lb.	.36 /	.38
Special	lb.	.36 /	1.00
Sheets, std.	lb.	.55 /	.60
Special	lb.	.55 /	.62
480, natural, black	lb.	.38 /	.40
Colors, std.	lb.	.41 /	.43
Special	lb.	.41 /	1.00
647, crystal	lb.	.305 /	.32
Colors, special	lb.	.345 /	1.34
666, 688, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
700, crystal	lb.	.295 /	.31
Colors, std.	lb.	.335 /	.35
Special	lb.	.335 /	1.00
777 colors, std.	lb.	.355 /	.375
Special	lb.	.355 /	1.00

Urea

Admirez SP-30	lb.	.27	
UP-50	lb.	.105	
Beetle C-4980, T-298	lb.	.1875/	.30
MUP series, powder	lb.	.30 /	.49
Special colors	lb.	.30 /	.39
Granules	lb.	.33 /	.52
Special colors	lb.	.33 /	.62
Plaskon molding cmpds.:			
Colors, single	lb.	.1875/	.30
Special	lb.	.30 /	.62
Standard	lb.	.30 /	.52
Foundry resins, liquid	lb.	.10 /	.13
Powdered	lb.	.2325/	.2525

Vinyls

Bakelite QG-5909	lb.	.37 /	.605
Colors	lb.	.42 /	.655
QG-5921	lb.	.43 /	.665
5924	lb.	.45 /	.685
QYNA, QYSM, QYSQ	lb.	.31 /	.51
QYNV	lb.	.34 /	.54
QYSJ	lb.	.35 /	.55
VG-1914, 1918	lb.	.39 /	.625
1985	lb.	.37 /	.605
5507	lb.	.33 /	.565
5544	lb.	.425 /	.66
5911	lb.	.335 /	.57
Colors	lb.	.385 /	.62
5980	lb.	.34 /	.575
9031	lb.	.285 /	.52
Colors	lb.	.335 /	.57
9530	lb.	.295 /	.53
Colors	lb.	.345 /	.58
VAGH	lb.	.55 /	.75
VMCH	lb.	.42 /	.62
VYDR, VYNW	lb.	.31 /	.51
VYHH	lb.	.35 /	.55
VYLF	lb.	.37 /	.57
VYNS	lb.	.45 /	.65
VYNV	lb.	.32 /	.52
Blacar No. BW-60	lb.	.315 /	.385
NEMA colors	lb.	.355 /	.425
No. BW-80	lb.	.405 /	.455
NEMA colors	lb.	.445 /	.495
No. PC white, ivory, black	lb.	.285 /	.335
Other colors	lb.	.325 /	.375
Darex Everplex A (wet wt.)	lb.	.21 /	.39
B (wet wt.)	lb.	.22 /	.40
G (wet wt.)	lb.	.21 /	.39
Copolymer Y (wet wt.)	lb.	.245 /	.28
PVA Emulsions (wet wt.)	lb.	.19 /	.355
Diamond PVC-45, -50	lb.	.38 /	.44
Dow PVC-100, -111	lb.	.38 /	.57
Exon 402A, 450, 468, 500, 900A, 905, 915, 925	lb.	.38 /	.56
400XR-61	lb.	9.75	
470	lb.	9.55	
471	lb.	9.50	
654 plastisol	lb.	.41 /	.59
700XR-59 latex	lb.	.38 /	.44
Formvar	lb.	.865 /	1.03
Gelva emulsions	lb.	.19 /	.205
Granules	lb.	.4175/	.6175
Geon 101, 101EP, 103EP, 202	lb.	.31 /	.49
121	lb.	.34 /	.52
126	lb.	.32 /	.50
200X20	lb.	.37 /	.55
205, 400X65, 400X74L, 400X78	lb.	.35 /	.53
400X80	lb.	.45 /	.63
400X110	lb.	.42 /	.60
404HI	lb.	.40 /	.58
2042, 2046	lb.	.335 /	.57
2042, colors	lb.	.385 /	.62
6373, 8372	lb.	.365 /	.60
Colors	lb.	.415 /	.65
6461	lb.	.345 /	.58
Colors	lb.	.395 /	.63
8539	lb.	.35 /	.585
Colors	lb.	.37 /	.605
8600, 8620	lb.	.295 /	.53
Colors	lb.	.345 /	.58
8630	lb.	.445 /	.68
Colors	lb.	.495 /	.73
8640	lb.	.37 /	.605
8650	lb.	.33 /	.565
8656	lb.	.38 /	.615
8677	lb.	.455 /	.69
8700A, 8750	lb.	.455 /	.69
Colors	lb.	.485 /	.72
8720	lb.	.625 /	.86
8726, 8737	lb.	.35 /	.585
8740	lb.	.315 /	.55
8749	lb.	.31 /	.545
8800	lb.	.55 /	.785
8801	lb.	.295 /	.53
Colors	lb.	.345 /	.58
8802	lb.	.35 /	.585
Colors	lb.	.40 /	.635
8804	lb.	.30 /	.535
8807	lb.	.45 /	.685
8809	lb.	.39 /	.625
8812, 8813, 8814, 8815	lb.	.345 /	.58
Latex 151, 251	lb.	.29 /	.75
351	lb.	.34 /	.75
352	lb.	.31 /	.75
552	lb.	.39 /	.75
576	lb.	.36 /	.75
652	lb.	.37 /	.75
Polyblend	lb.	.445 /	.545
Goodrich PVC Plastisols (dry wt.)	lb.	.38 /	.72
Krene, film	lb.	.56 /	.71
Sheeting	lb.	.55 /	.66
Marvinols, VR series	lb.	.31 /	.53
Opalon 300, 300FM	lb.	.31 /	.51
410	lb.	.34 /	.54
505	lb.	.35 /	.55
Inj. molding cmpds.	lb.	.29 /	.67
Profile extrusion cmpds.	lb.	.29 /	.72
Wire cmpds.	lb.	.29 /	.67
Plastiflex, std.	lb.	.90 /	1.10
Novelty	lb.	1.15 /	1.50
Pliovic resins	lb.	.38 /	.40
Reynolon, 4000 series	lb.	1.55 /	2.30
Rolls, 1-mil	sq. yd.	.0625/	.11
Colors	sq. yd.	.0675/	.08
4-mil	sq. yd.	.215 /	.3125
Colors	sq. yd.	.2375/	.255
16-mil	sq. yd.	.81 /	1.19
Colors	sq. yd.	.86 /	.945
Satinflex	lb.	1.15 /	1.50

Vinylidine

Dow Latex 744-B	lb.	.30 /	.46
Saran formulation 115, black, nat.	lb.	.39 /	.52
Colors	lb.	.44 /	.69
720 nat.	lb.	.41 /	.54
Colors	lb.	.46 /	.71
747 nat.	lb.	.395 /	.525
761 nat.	lb.	.39 /	.52
Colors	lb.	.44 /	.69
820 nat.	lb.	.42 /	.55
Colors	lb.	.47 /	.60
Latices	lb.	.45 /	.61
Resin F 120	lb.	.58 /	.65

Plasticizers

Adipol 2EH, 10A, 810, XX	lb.	.425 /	.455
BCA	lb.	.45 /	.475
ODY	lb.	.47 /	.50
Barrett dibutyl phthalate	lb.	.30 /	.34
Dimethyl phthalate	lb.	.275 /	.315
Iso-octyl iso-decyl phthalate	lb.	.305 /	.345
Benzoflex 2-45	lb.	.26 /	.29
9-88	lb.	.32 /	.35
Cabflex DDA, Di-OA, DOA, ODA	lb.	.425 /	.455
DDP, Di-OP, DOP, ODP	lb.	.305 /	.335
Di-BA	lb.	.4325/	.4625
Di-OZ	lb.	.48 /	.5075
HS-10	lb.	.44 /	.47
TCP	lb.	.33 /	.36
Cabol 100	lb.	.02 /	.11
Chlorowax 40	lb.	.155 /	.165
70	lb.	.18 /	.19
70S	lb.	.21 /	.22
LV	lb.	.175 /	.185
Darex dibutyl phthalate	lb.	.30 /	.33
DIOP	lb.	.305 /	.355
DOP	lb.	.305 /	.335
Dinopol 235	lb.	.355 /	.385
IDO	lb.	.305 /	.335
MOP	lb.	.325 /	.355
Dow Plasticizer No. 5	lb.	.315 /	.54
Resin 276-V2,-V9	lb.	.265 /	.325
Drapex 3.2	lb.	.40 /	.49
Dutch Boy Plasticizer NL-A10 (DBP)	lb.	.30 /	.33
NL-A20 (DOP), NL-A30 (DIOP)	lb.	.305 /	.335
NL-C20 (DOS)	lb.	.61 /	.63
NL-F21	lb.	.395 /	.425
NL-F31	lb.	.44 /	.47
NL-F41	lb.	.48 /	.51
NL-A54	lb.	.295 /	.325
Elastex 10-P, 28-P	lb.	.305 /	.345
18-P	lb.	.305 /	.335
40-P	lb.	.27 /	.31
50-B	lb.	.25 /	.29
60-A	lb.	.425 /	.455
80-P	lb.	.295 /	.335
90-P	lb.	.305 /	.345
DCHP	lb.	.59 /	.61
Ethox	lb.	.50 /	.525
Flexol 2GB	lb.	.35 /	.3775
3G	lb.	.53 /	.55
3GH	lb.	.44 /	.46
3GO	lb.	.53 /	.55
4GO	lb.	.325 /	.355
8N8	lb.	.355 /	.395
10-10, 810, CC-55, DOP	lb.	.305 /	.335
77-G, 426	lb.	.27 /	.31
A-26	lb.	.425 /	.455
B-400	lb.	.25 /	.29
R2H	lb.	.59 /	.595
T0F	lb.	.435 /	.475
TWS	lb.	.41 /	.4375
Flexricin P-4	lb.	.30	
P-6	lb.	.36	
P-8	lb.	.32	
Good-rite GP-261	lb.	.305 /	.460
GP-233	lb.	.435 /	.585
Harflex 10	lb.	1.25 /	1.27
40	lb.	.66 /	.68
50, 80	lb.	.61 /	.63
60	lb.	.62 /	.64
90	lb.	.88 /	.90
120, 150	lb.	.305 /	.335
140, 160	lb.	.30 /	.33
180	lb.	.295 /	.325
220	lb.	.435 /	.465
260	lb.	.42 /	.45
280	lb.	.43 /	.46
300	lb.	.63 /	.66
500	lb.	.315 /	.345
Butyl stearate	lb.	.23 /	.26
Kapsol	lb.	.3225/	.3525
KP-23	lb.	.29 /	.32
-90	lb.		
-140	lb.	.46 /	.485
-201	lb.	.5825/	.5925
-220	lb.	.31 /	.34
-555	lb.	.45 /	.475
Kronisol	lb.	.33 /	.355
Kronitex AA, I, K-3, MX	lb.	.33 /	.36
Marvinol decylbutyl phthalate	lb.	.27 /	.30
Dibutyl phthalate	lb.	.30 /	.33
Sebacate	lb.	.665 /	.69
Diisooctyl adipate	lb.	.435 /	.465
Phthalate	lb.	.305 /	.335
Dinonyl adipate	lb.	.445 /	.475
Dioctyl adipate	lb.	.435 /	.465
Phthalate	lb.	.305 /	.365
Sebacate	lb.	.615 /	.64
Epoxy plasticizer	lb.	.345 /	.37
Isooctyl decyl phthalate	lb.	.305 /	.335
Tricresyl phosphate	lb.	.33 /	.36
Methox	lb.	.385 /	.41
Monsanto dibutyl phthalate	lb.	.30 /	.33
Diethyl phthalate	lb.	.25 /	.28
Dimethyl phthalate	lb.	.275 /	.305
Diphenyl phthalate	lb.	.5175/	.5375
DIDA, DOA	lb.	.425 /	.455
DIDP, DIOP, DOP	lb.	.305 /	.335
HB-20	lb.	.15 /	.17
HB-40	lb.	.22 /	.24
Orthonitrobiphenyl	lb.	.13 /	.15
Tricresyl phosphate	lb.	.33 /	.36
Triphenyl phosphate	lb.	.39 /	.40
Naugatuck decylbutyl phthalate	lb.	.29 /	.30
Dibutyl phthalate	lb.	.30 /	.33
Sebacate	lb.	.645 /	.67
Diisooctyl adipate, dioctyl adipate	lb.	.425 /	.455
Diisooctyl phthalate, dioctyl phthalate, Isooctyl decyl phthalate	lb.	.305 /	.335
Dinonyl adipate	lb.	.445 /	.475
Dioctyl sebacate	lb.	.585 /	.61
Epoxy plasticizer	lb.	.335 /	.36
Tricresyl phosphate	lb.	.33 /	.36
Ohio-Apex butyl oleate	lb.	.2325/	.26
Stearate	lb.	.22 /	.25
Diallyl phthalate	lb.	.4975/	.5225
Dibutyl phthalate	lb.	.30 /	.33
Dicapryl phthalate	lb.	.295 /	.325
Di-Carbitol phthalate	lb.	.40 /	.425
Diisobutyl adipate	lb.	.4325/	.4625
Diisodecyl phthalate	lb.	.305 /	.335
Dioctyl phthalate	lb.	.305 /	.335
D.I.O.P.	lb.	.305 /	.335
Tributyl phosphate	lb.	.50 /	.53
Ohopex Q-10	lb.	.295 /	.325
R-9	lb.	.3525/	.3775
Paraplex G-60, G-61	lb.	.3251/	.35
Pfizer acetyl tributyl citrate, tech.	lb.	.32 /	.57
Acetyl triethyl citrate, tech.	lb.	.36 /	.57
Triethyl citrate	lb.	.4575/	.58
Plasticizer 1	lb.	1.17 /	1.37
Plasticizer 120	lb.	.44 /	.49
Plastoflex #3	lb.	.52 /	.57
#520	lb.	.36 /	.435
D B E	lb.	.50 /	.55
MGB	lb.	.29 /	.37
SP-2	lb.	.43 /	.48
VS	lb.	.38 /	.4575
Plastolein 9050 DHZ	lb.	.52 /	.555
9055 DGP	lb.	.28 /	.315
9057 DIOZ	lb.	.48 /	.515
9058 DOZ	lb.	.48 /	.515
9250 THFO	lb.	.3425/	.3775
9715 Polymeric	lb.	.37 /	.405
9720 Polymeric	lb.	.37 /	.405
Polycizer 162, 562, 662	lb.	.305 /	.335
332, 532, 632	lb.	.425 /	.455
PX-104	lb.	.30 /	.39
-108, -118, -138	lb.	.305 /	.395
-114	lb.	.27 /	.36
-208, -238	lb.	.435 /	.525
-209	lb.	.445 /	.535

404	lb.	.665 /	.75
438	lb.	.615 /	.70
809	lb.	.345 /	.43
917	lb.	.33 /	.42
Pycal 40	lb.	.3875/	.4375
60	lb.	.60 /	.635
62	lb.	.80 /	.835
94	lb.	.3275/	.3775
140	lb.	.35 /	.40
170	lb.	.275 /	.325
194	lb.	.2775/	.3275
Santicizer 1-H	lb.	.50 /	.51
3	lb.	.46 /	.47
8	lb.	.43 /	.44
9	lb.	.39 /	.42
140	lb.	.33 /	.36
141	lb.	.34 /	.37
160	lb.	.25 /	.28
601	lb.	.32	
602	lb.	.305	
B-16	lb.	.4875/	.4975
E-15	lb.	.5075/	.5375
M-17	lb.	.4275/	.4575
Staflex AX	lb.	.43	
BR	lb.	.26 /	.29
CP	lb.	.28 /	.31
DBES, DOS	lb.	.61 /	.635
DIOA, ODA	lb.	.435 /	.465
DIOP, DOP, MP	lb.	.305 /	.335
DOZ	lb.	.48 /	.5075
IXA	lb.	.32 /	.35
KA	lb.	.36 /	.3875
KD	lb.	.44 /	.4675
Witcizer #100	lb.	.26 /	.27
#101	lb.	.31 /	.32
#200	lb.	.195 /	.205
#201	lb.	.235 /	.245
#300	lb.	.30 /	.33
#312, 313	lb.	.305 /	.33
#412	lb.	.435 /	.465

Solvents

Enjayacetone	gal.	.07 /	.10
Isopropyl acetate	gal.	.10 /	.13
Methyl ethyl ketone	gal.	.11 /	.14
Secondary butyl acetate	gal.	.1075/	.1375
Butyl alcohol	gal.	.11 /	.14
Petrohol 91%	gal.	.35 /	.55
95%	gal.	.37 /	.57
99%	gal.	.39 /	.59

Stabilizers

Advastab #3, #52, OM-10	lb.	1.90 /	2.00
17-M	lb.	3.00 /	3.25
#21	lb.	1.00 /	1.18
#21 new, #143, E-6-B	lb.	.80 /	.90
#42	lb.	.83 /	.93
#48-70, C-77, XE-82	lb.	.85 /	.95
50-LT, P-1835, T-72	lb.	3.20 /	3.35
89-X	lb.	.75 /	.80
BA-13-P, BC-105	lb.	.75 /	.85
BC-12	lb.	.87 /	.95
CH-14, -20	lb.	.63 /	.70
E-49	lb.	.60 /	.65
E-98	lb.	.55 /	.65
JCX	lb.	.62 /	.68
L paste	lb.	.65 /	.70
OM-18	lb.	3.10 /	3.35
P-1835, T-72	lb.	3.20 /	3.35
PS-38, ZN-9	lb.	.50 /	.65
SN	lb.	.47 /	.53
V-1-N	lb.	.40 /	.48
VL-3	lb.	.95 /	1.05
X23-74	lb.	.70 /	.80
X30-6	lb.	.60 /	.70
X30-15	lb.	.65 /	.75
Barca 10	lb.	.75 /	.80
Baker barium ricinoleate	lb.	.70	
Calcium ricinoleate	lb.	.55	
Dutch Boy Barinac	lb.	.70	
Calstar	lb.	.36	
CS-137	lb.	1.25	
DS-207	lb.	.54 /	.555
Dyphos	lb.	.57 /	.585
50A	lb.	.335	
Dythal	lb.	.395 /	.41
L-26	lb.	.50	
Leadstar	lb.	.39	
Normal lead maleate	lb.	.4475	
Normasal	lb.	.46	
Pearlescent pigment	lb.	1.00	
Plumb-O-Sil-A	lb.	.2975	
-B	lb.	.3125/	.36
-C	lb.	.3425/	.375
Tribase	lb.	.265 /	.28
-E	lb.	.215	
Trimal	lb.	.435	
Harshaw 1-V-3	lb.	.43	
1-V-4	lb.	.68	
1-V-7	lb.	.66 /	.71
2-V-4	lb.	.85 /	.90
2-V-7	lb.	1.10 /	1.15
2-V-8	lb.	1.30	
2-V-400	lb.	.80 /	.85
5-V-1	lb.	.41	
5-V-22	lb.	.49	
7-V-1	lb.	.90 /	.95
7-V-2	lb.	.95 /	1.00
7-V-4	lb.	1.18 /	1.23
8-V-1	lb.	1.10 /	1.15
8-V-5	lb.	.80 /	.85
8-V-100	lb.	.84 /	.89
9-V-1	lb.	.76 /	.81
12-V-5	lb.	.75	
22-V-1	lb.	1.28	
24-V-1	lb.	1.28 /	1.33
28-V-2	lb.	1.18	
128-V-5	lb.	.86	
281-V-4	lb.	.90	
Metasap 613-A	lb.	.69	
613-B	lb.	.84	
613-C	lb.	1.06	
621	lb.	.88	
624	lb.	.75	
Cadmium stearate	lb.	1.40 /	1.44
Fused stearates, calcium 602-A	lb.	.25 /	.30
Dibasic lead stearate	lb.	.56	
Lead 611	lb.	.32 /	.37
Lead stearate	lb.	.39 /	.44
Nuostable V-1	lb.	.54 /	.59
V-2	lb.	.39 /	.44
V-10	lb.	.70 /	.75
V-20	lb.	1.30 /	1.35
V-21	lb.	1.29 /	1.34
V-30	lb.	.90 /	.95
V-31	lb.	.80 /	.85
V-40	lb.	1.18 /	1.23
V-42	lb.	.65 /	.70
V-43	lb.	.75 /	.80
V-44	lb.	.90 /	.95
V-45	lb.	1.10 /	1.15
V-50	lb.	.49 /	.54
V-60	lb.	.37 /	.42
V-70	lb.	.68 /	.73
V-80	lb.	2.80 /	2.85
V-81	lb.	2.90 /	2.95
Stabelan E	lb.	1.35 /	1.50
HR, liquid	lb.	.65 /	.75
Paste	lb.	.85 /	.95
Powder	lb.	.95 /	1.05
HR-50	lb.	.75 /	.90
XL	lb.	.55 /	.65
Stabilizer #3, 52	lb.	1.90 /	2.00
17-M	lb.	3.00 /	3.25
#42	lb.	.83 /	.93
89-X	lb.	.75 /	.80
#143	lb.	.80 /	.90
A-5	lb.	1.25	
BC-12	lb.	.87 /	.95
BC-105	lb.	.75 /	.85
C-2	lb.	1.65	
C-77	lb.	.85 /	.95
CH-14	lb.	.63 /	.70
CH-20	lb.	.63 /	.65
D-22	lb.	1.99 /	2.05
E-6-B	lb.	.80 /	.90
E-49	lb.	.60 /	.65
E-98	lb.	.55 /	.65
JCX	lb.	.62 /	.68
L-Paste	lb.	.60 /	.65
Mark E	lb.	.72 /	.85
M	lb.	.73 /	.83
PL	lb.	.74 /	.84
TT	lb.	.77 /	.91
V	lb.	.91 /	1.04
X	lb.	2.50 /	2.75
XI	lb.	.87 /	1.01
XV	lb.	.92 /	1.01
XX	lb.	.63 /	.74
OM-10	lb.	1.90 /	2.00
-18	lb.	3.10 /	3.35
P-1835	lb.	3.20 /	3.35
PS-38	lb.	.50 /	.65
SN	lb.	.47 /	.53
T-72	lb.	3.20 /	3.35
V-I-N	lb.	.40 /	.48
VL-3	lb.	.95 /	1.05
Staflex OMXA	lb.	.70	
50% in DOP	lb.	.52	
OY	lb.	1.90 /	1.20
Stayrite #10	lb.	.33 /	.37
#15	lb.	.54 /	.57
#20	lb.	.38 /	.42
#22	lb.	1.32 /	1.34
#25	lb.	.36 /	.40
#70, 75, 80, 90	lb.	.69 /	.70
#229	lb.	.47 /	.50
P-10	lb.	.48 /	.44
Thermolite No. 12	lb.	2.00 /	2.25
13	lb.	3.10 /	3.75
15	lb.	4.13	
17, 99	lb.	3.00	
20	lb.	3.25	
31	lb.	3.05 /	3.25
Vanstay HT	lb.	.90 /	.92
L	lb.	.33 /	.35
R	lb.	.88 /	.90
S	lb.	.63 /	.65

Wetting Agents

Advawet X-212	lb.	.50 /	.55
Poly-lube No. 4	gl.	1.45 /	1.94